THE STUDY OF THE ORIGIN AND BRANCHING PATTERN OF THE POPLITEAL ARTERY PERTAINING TO THE POPLITEAL FOSSA AND ITS CLINICAL SIGNIFICANCE

Submitted in partial fulfillment for

M.D.DEGREE EXAMINATION

BRANCH XXIII – ANATOMY

Department of Anatomy

Stanley Medical College, Chennai .

TAMILNADU Dr. M.G.R.MEDICAL UNIVERSITY

CHENNAI-600 003

APRIL – 2013

CERTIFICATE

This is to certify that the dissertation on **‘ THE STUDY OF THE ORIGIN AND BRANCHING PATTERN OF THE POPLITEAL ARTERY PERTAINING TO POPLITEAL FOSSA AND ITS CLINICAL SIGNIFICANCE’** is a bonafide work done by Dr.B.Anbumalar in the Department of Anatomy, Stanley Medical College, Chennai-600 001,during 2010-2013 under my supervision and guidance in partial fulfillment of the regulation laid down by The Tamilnadu Dr.M.G.R.Medical University, for the M.D.Anatomy,(Branch XXIII) examination to be held in April – 2013.

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DECLARATION

I solemnly declare that this dissertation **‘ THE STUDY OF THE ORIGIN AND BRANCHING PATTERN OF THE POPLITEAL ARTERY PERTAINING TO POPLITEAL FOSSA AND ITS CLINICAL IMPORTANCE’** was written by me in the Department of Anatomy, Stanley Medical College and Hospital Chennai, under the guidance and supervision of **prof.Dr.S.Chitra, M.S.,** Professor and Head of the Department of Anatomy, Govt.Stanley Medical College, Chennai – 600 001.

This dissertation is submitted to **THE TAMILNADU Dr. M.G.R MEDICAL UNIVERSITY** Chennai, in partial fulfillment of the university regulations for the award of **DEGREE OF M.D ANATOMY (BRANCH-XXIII)** examinations to be held in **APRIL – 2013.**

Date :

Place : Chennai **Dr.B.ANBUMALAR**

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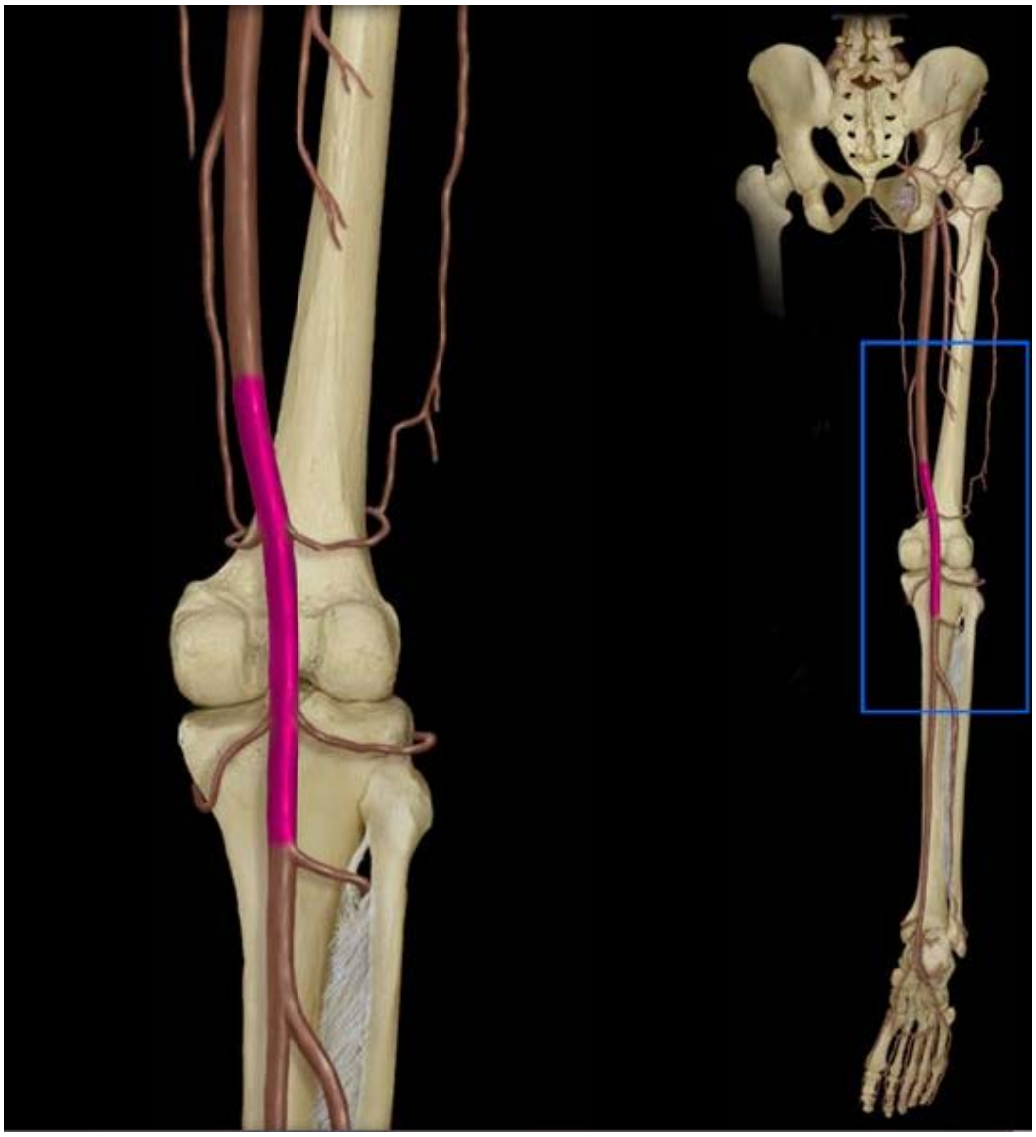

Figure 1: popliteal artery –extent { shaded in pink}

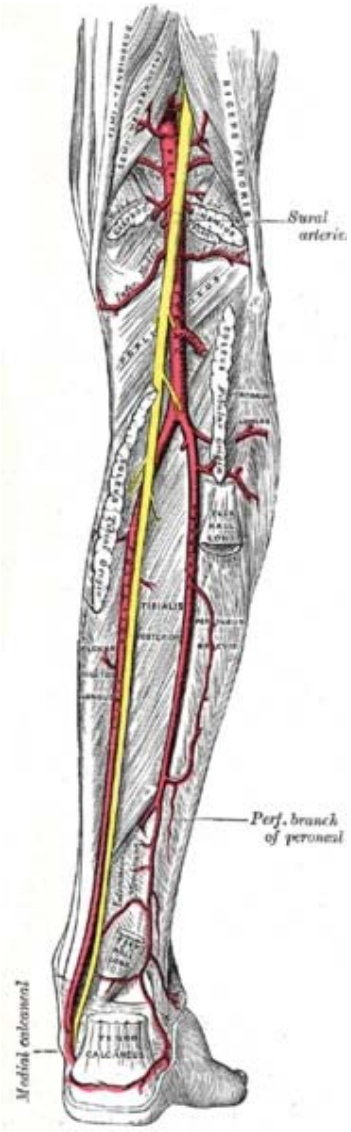

Figure 2: popliteal fossa and its contents

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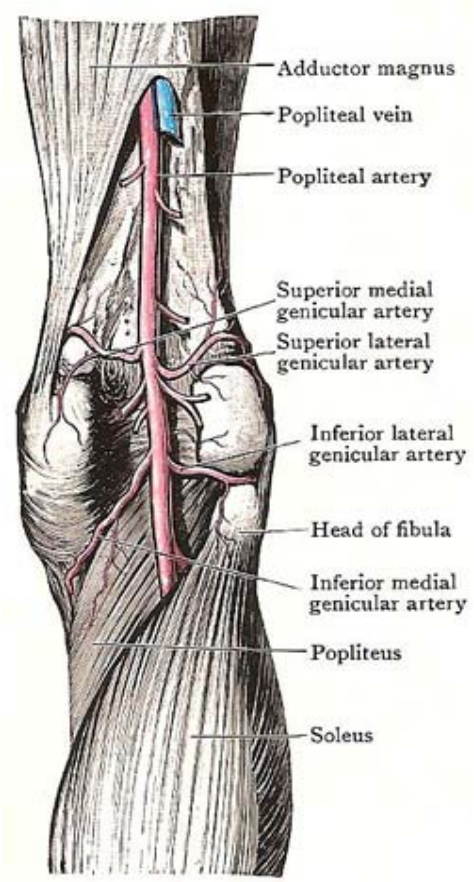

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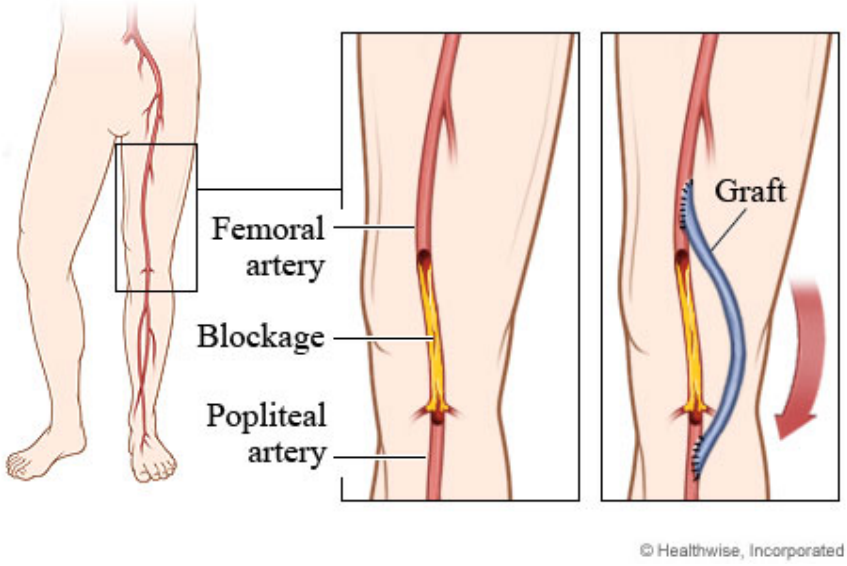

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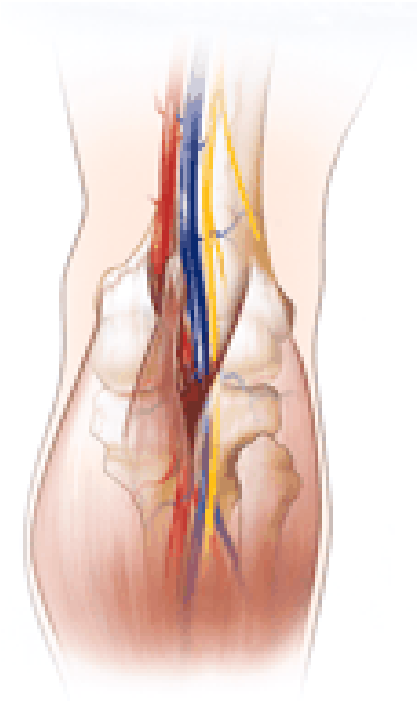

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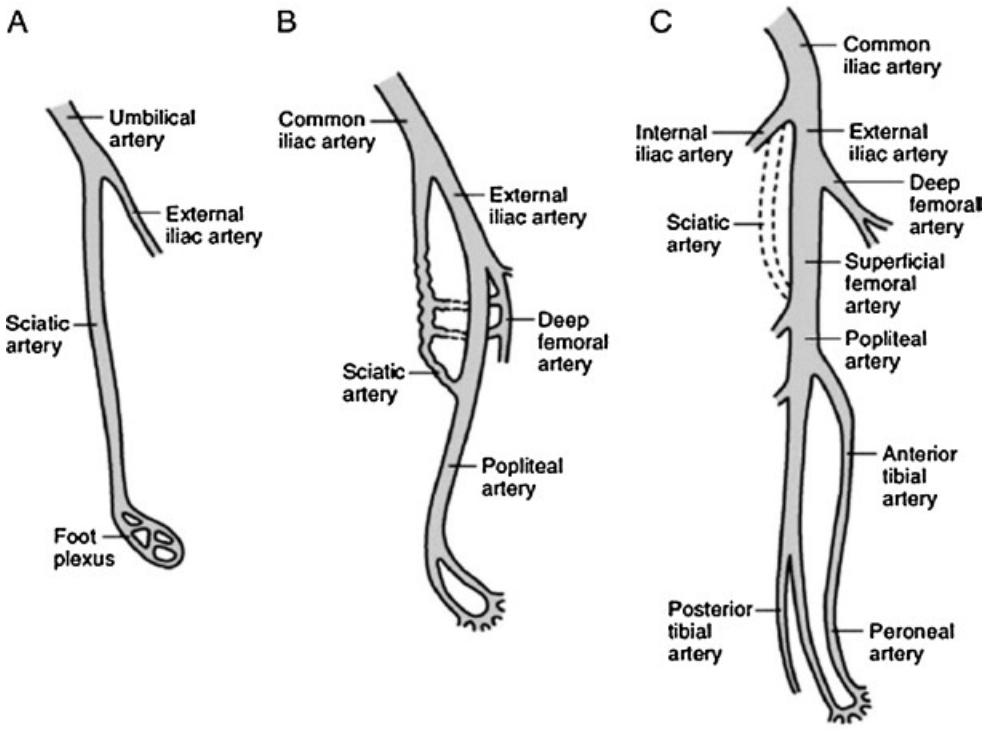

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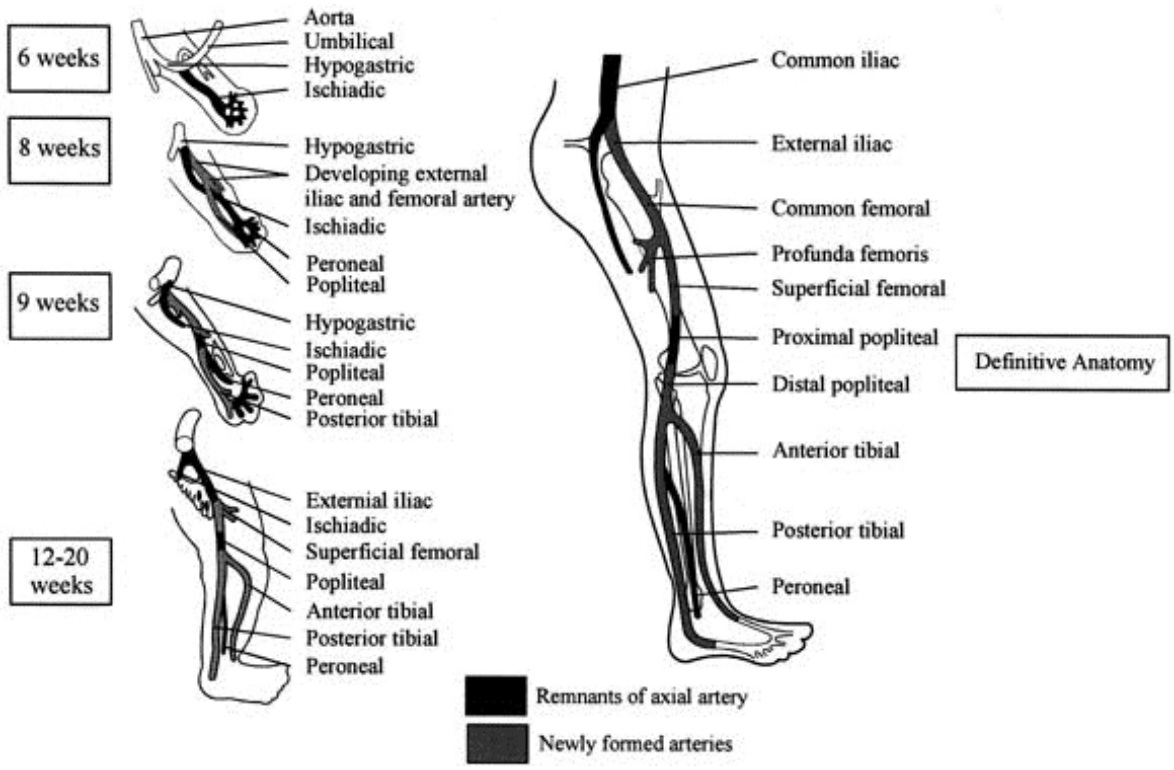

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FOETAL STUDY

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ADULT CADAVERIC STUDY

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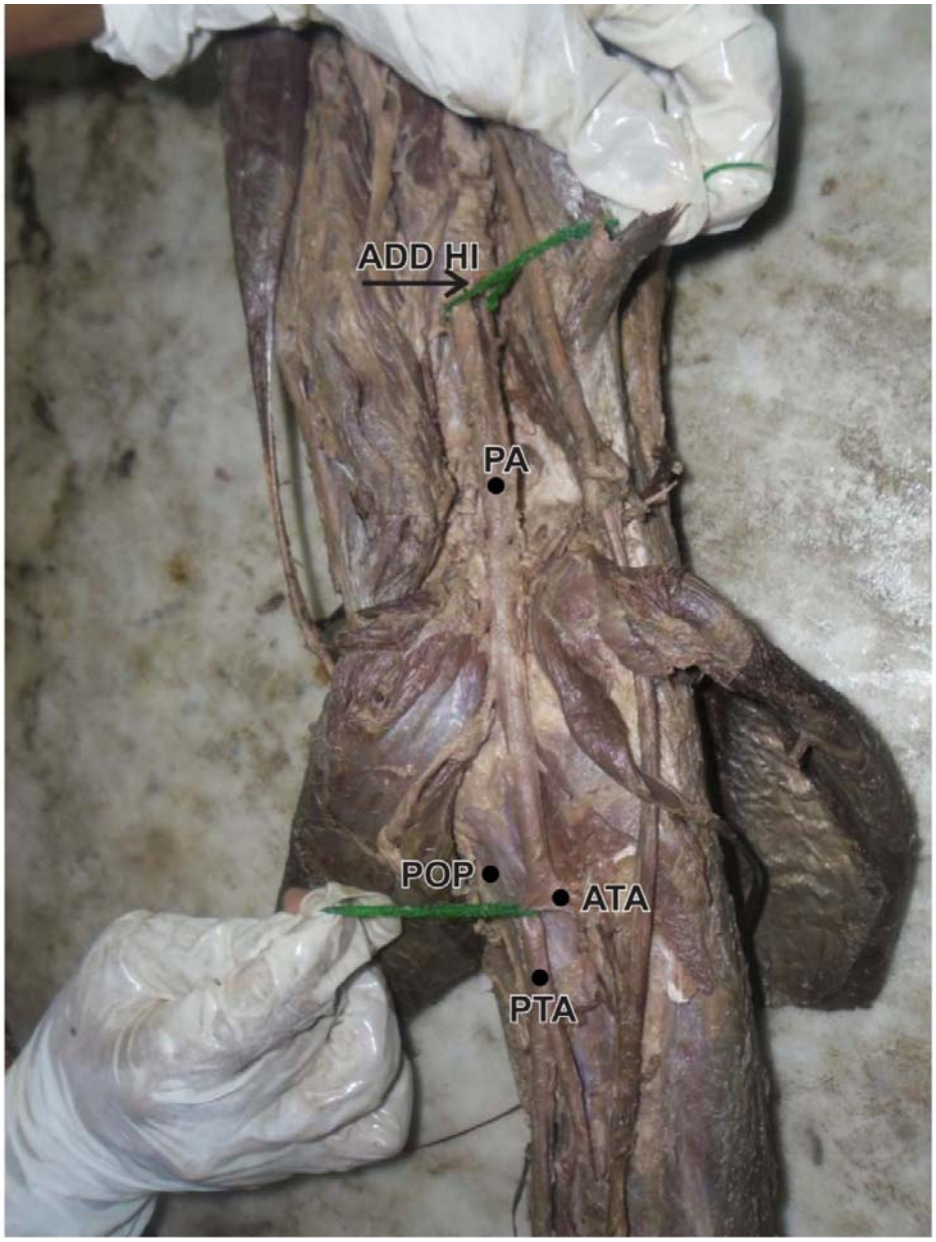

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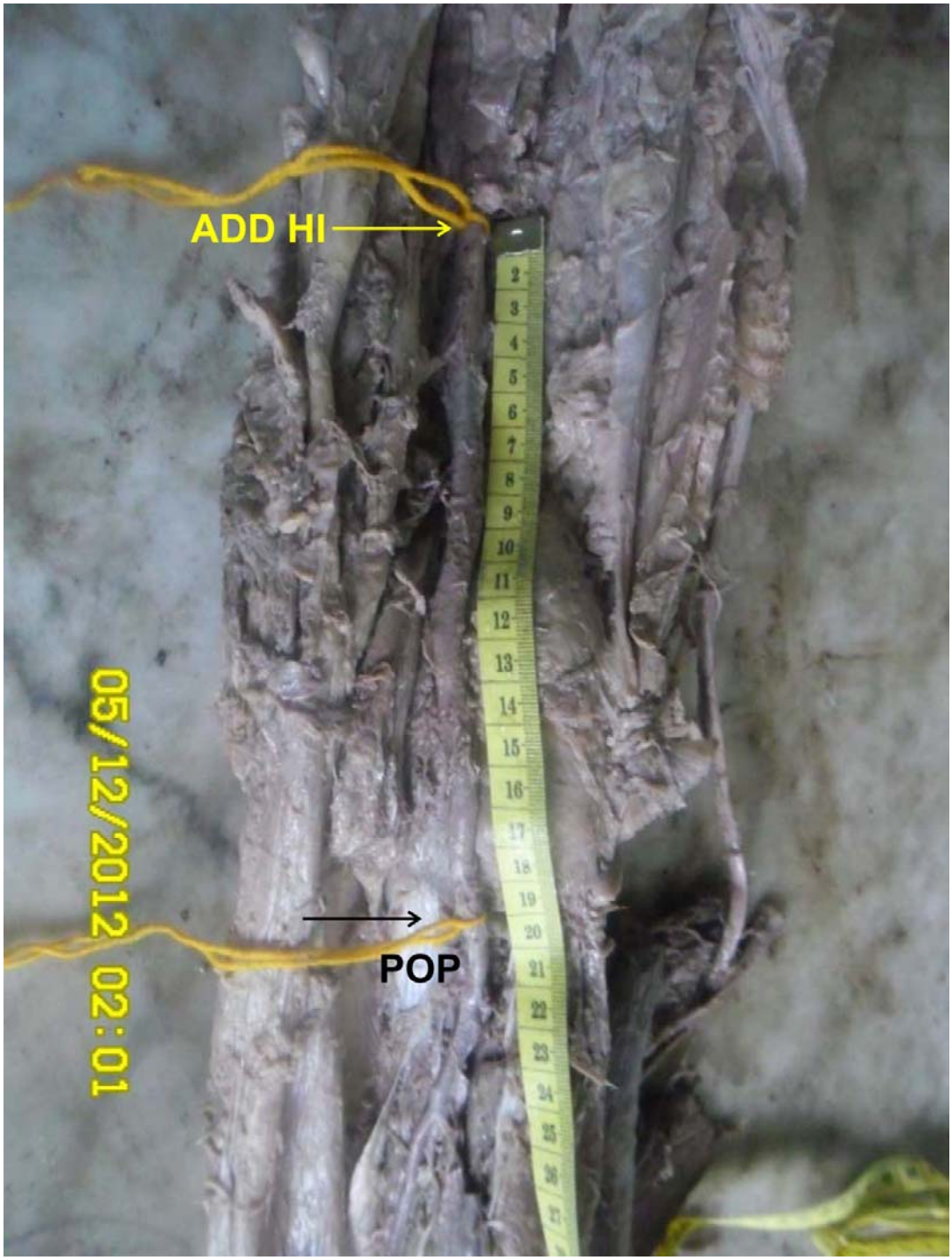

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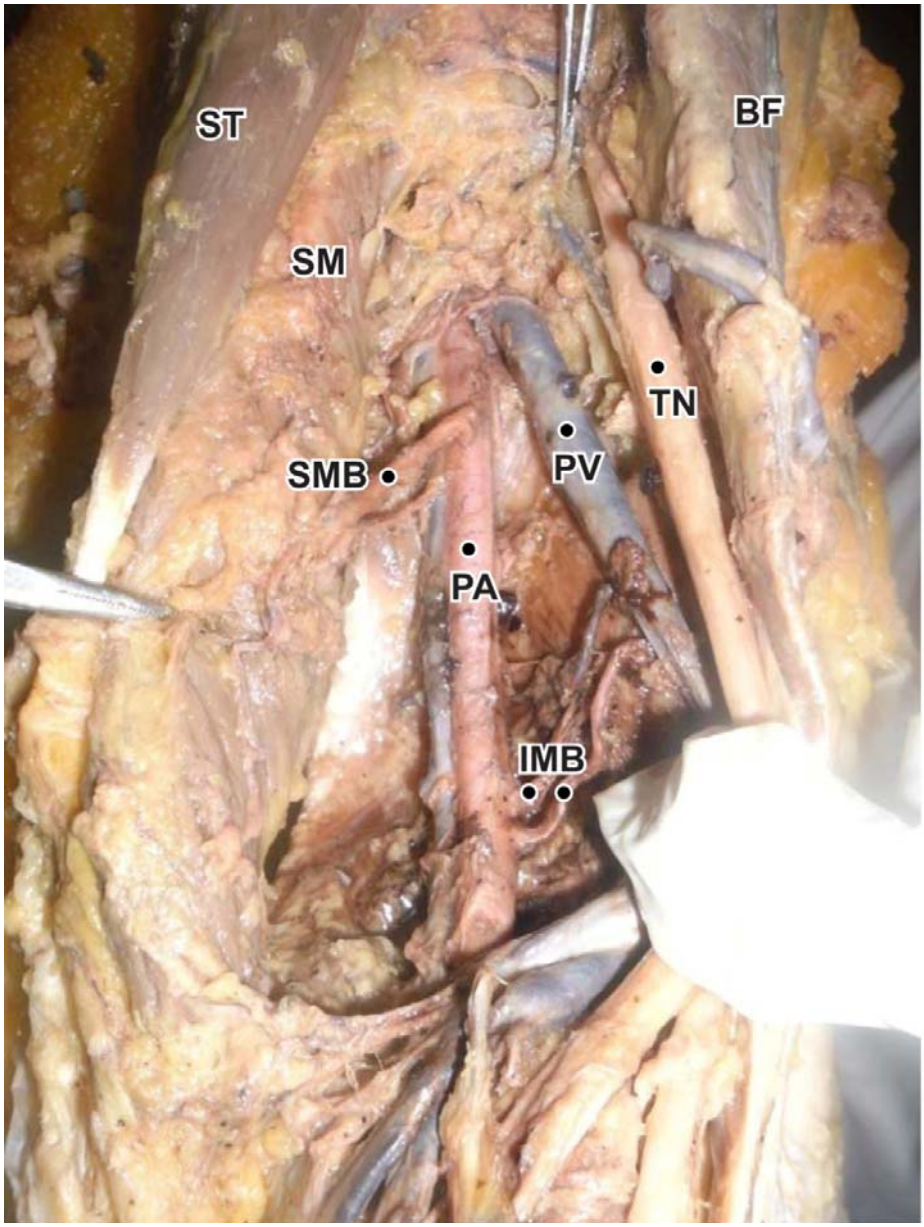

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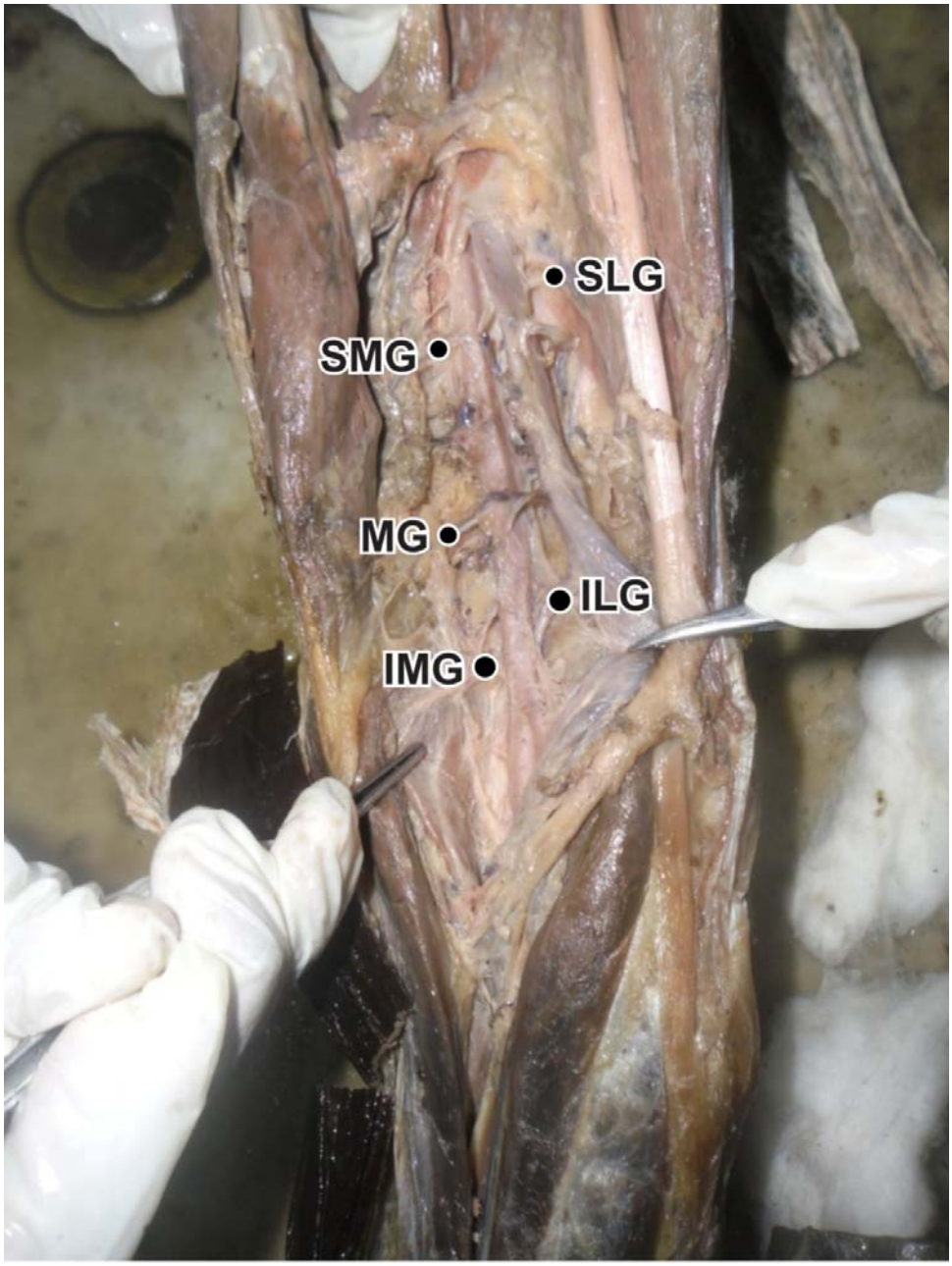

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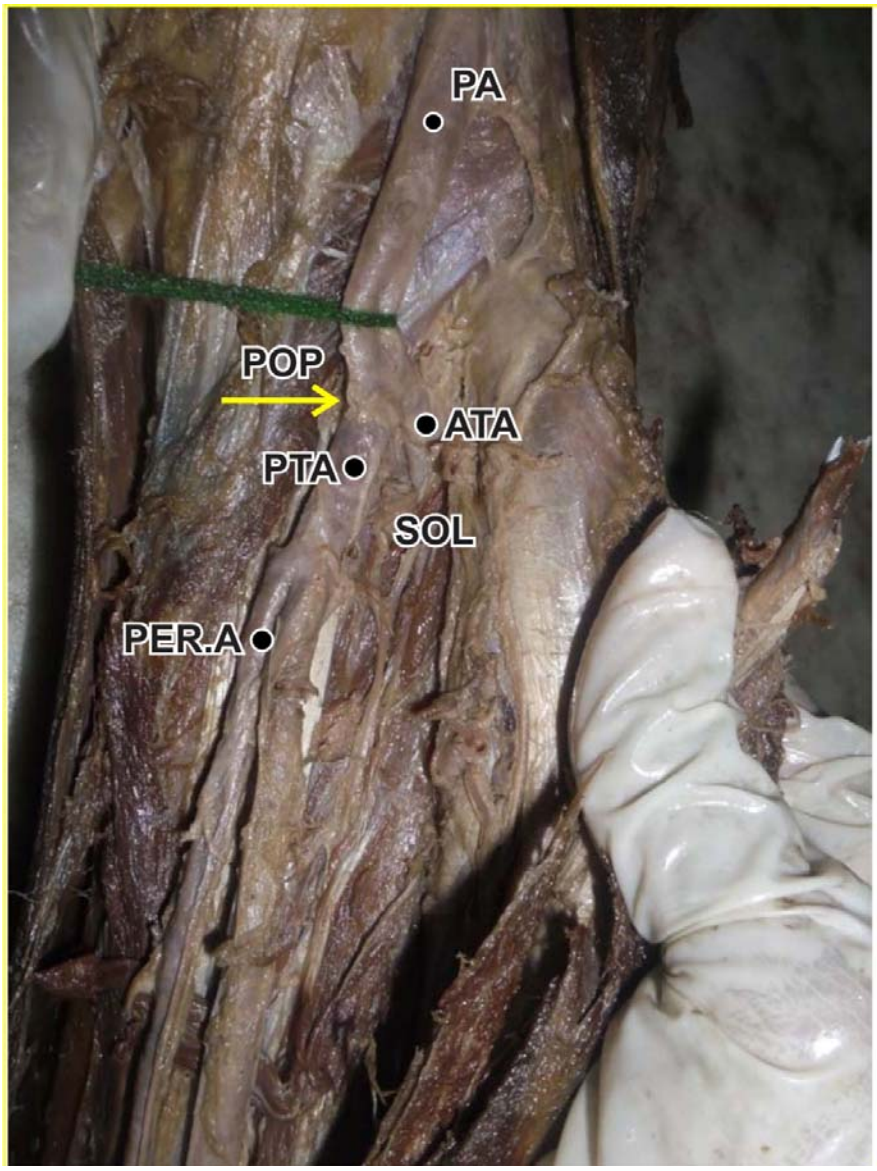

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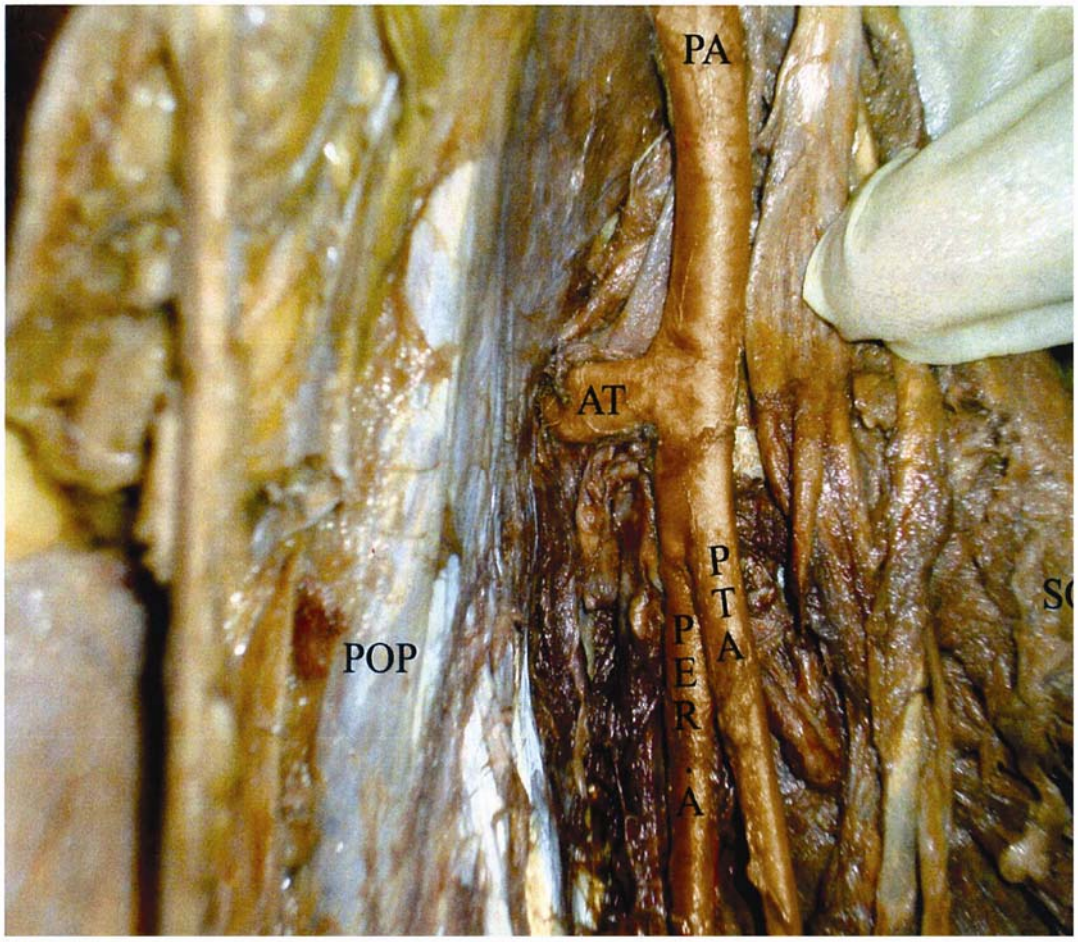

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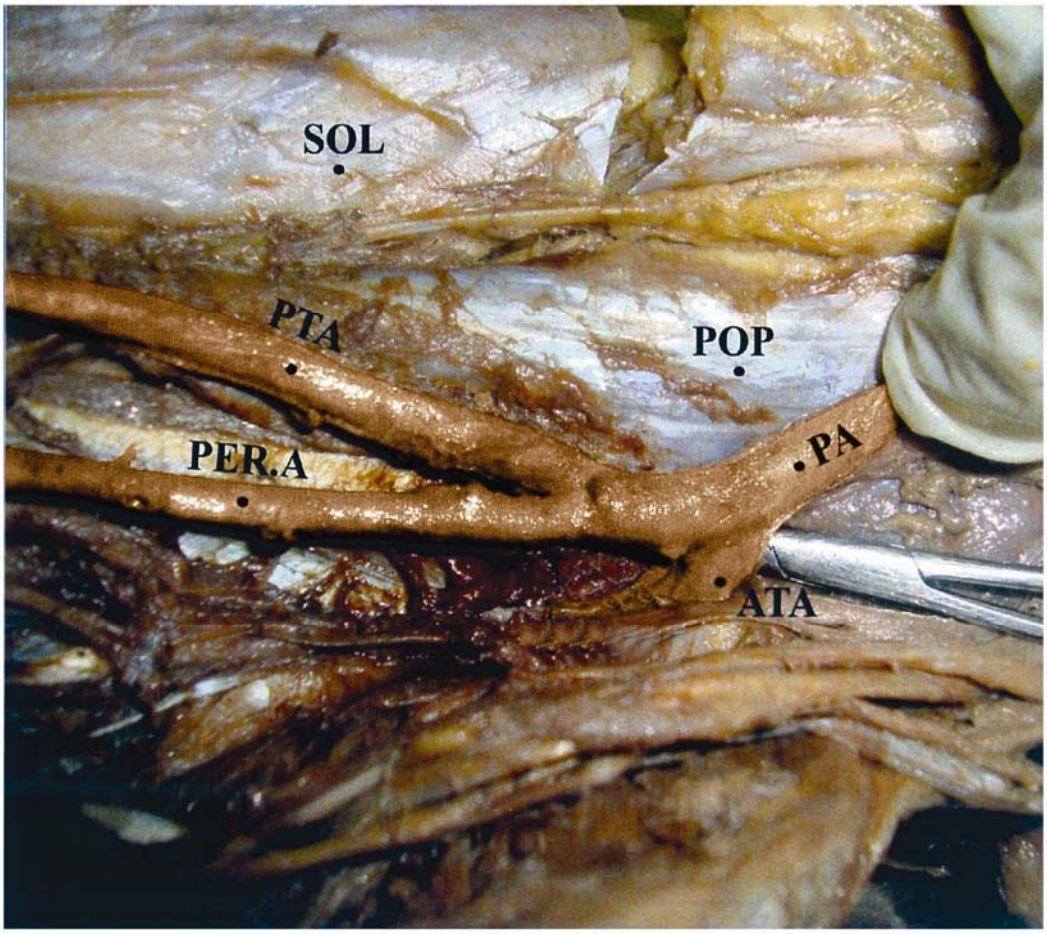

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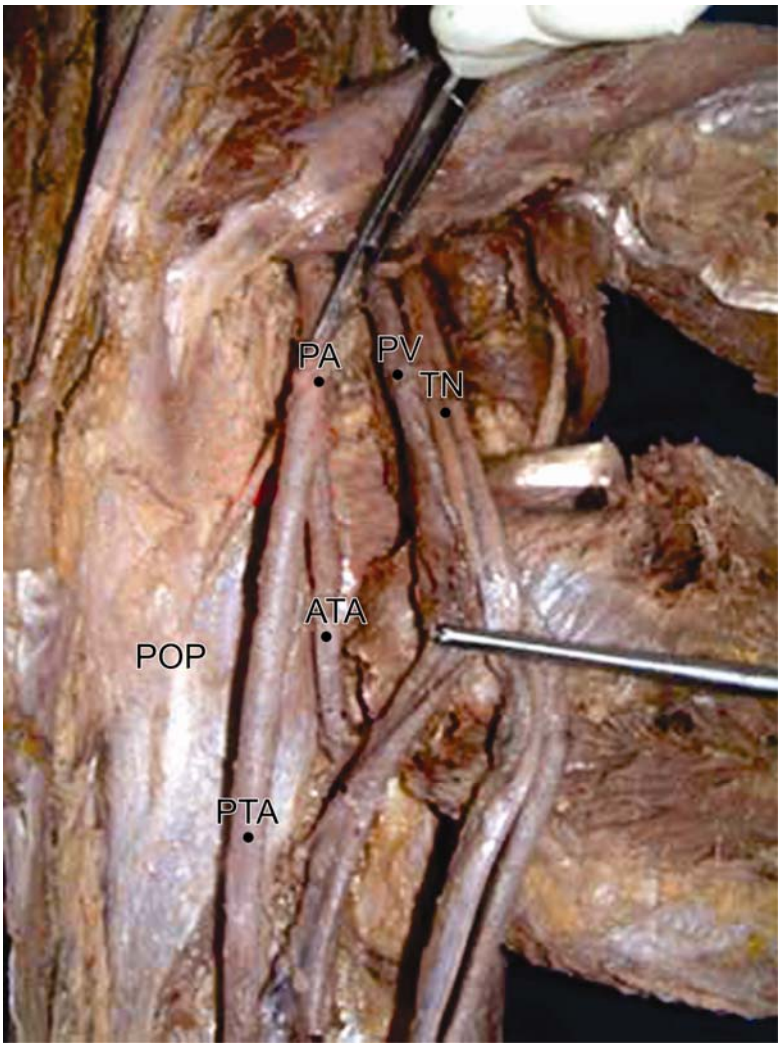

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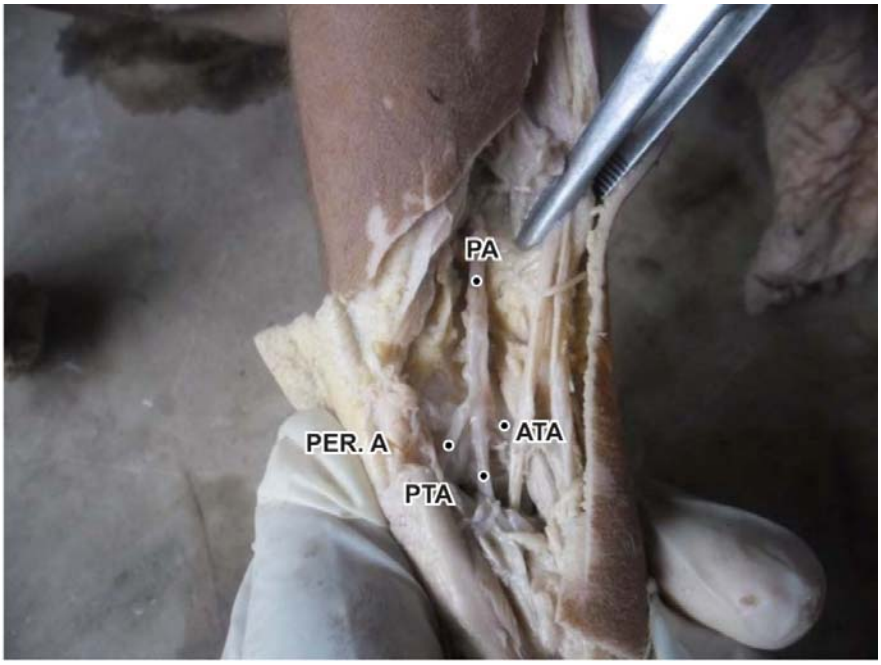

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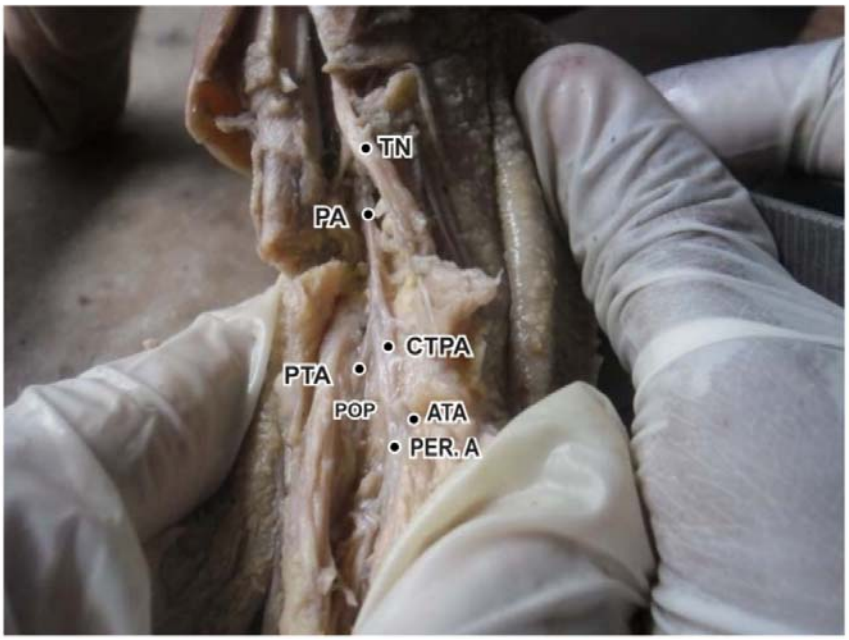

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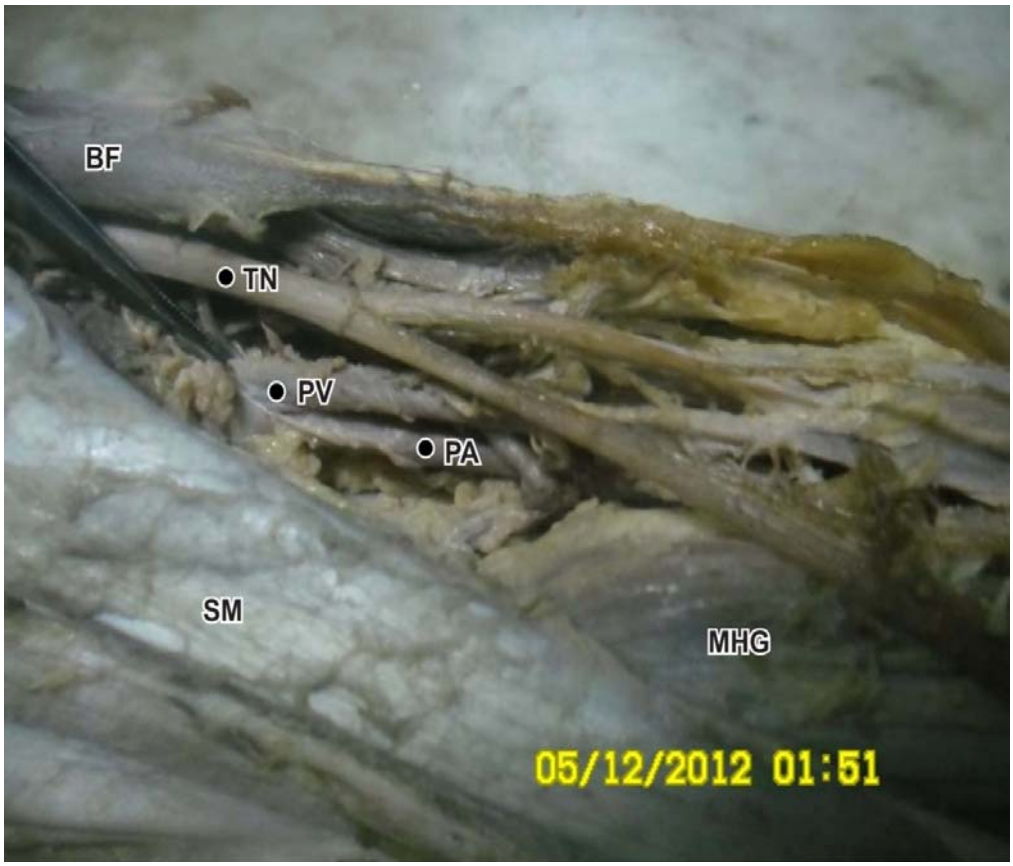

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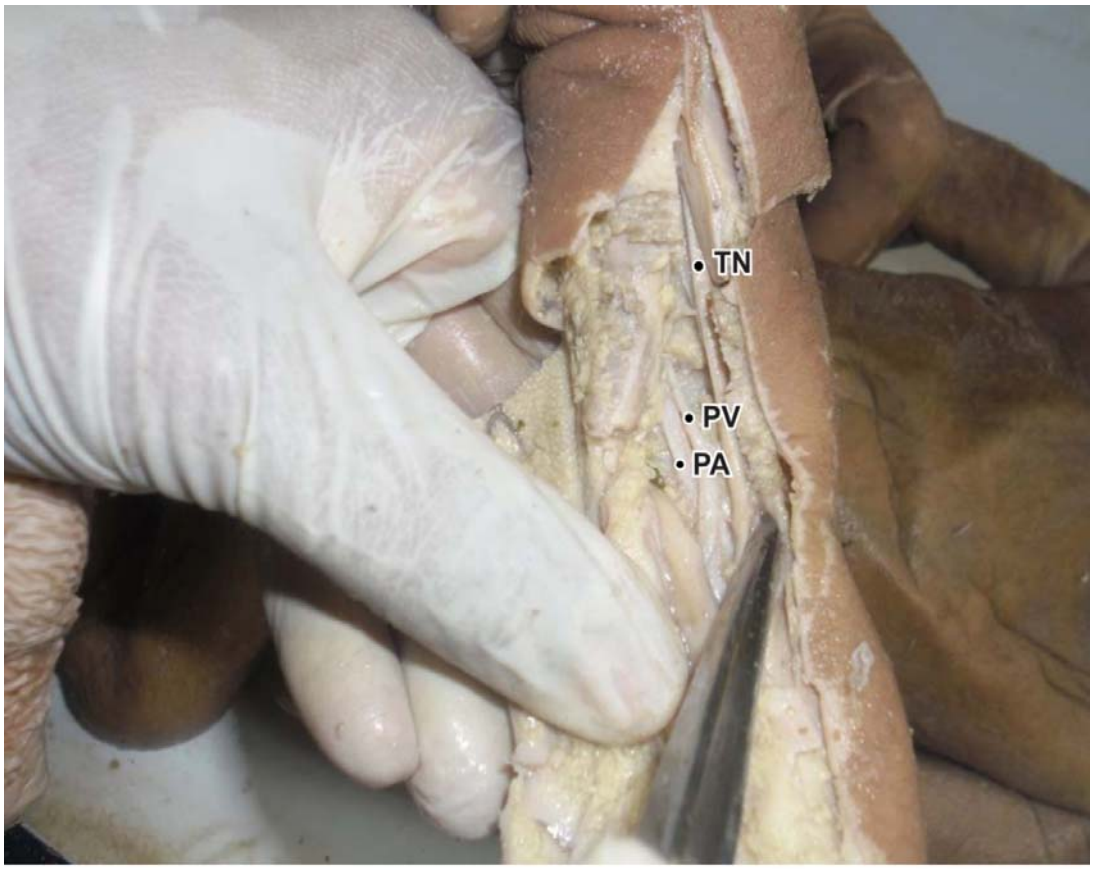

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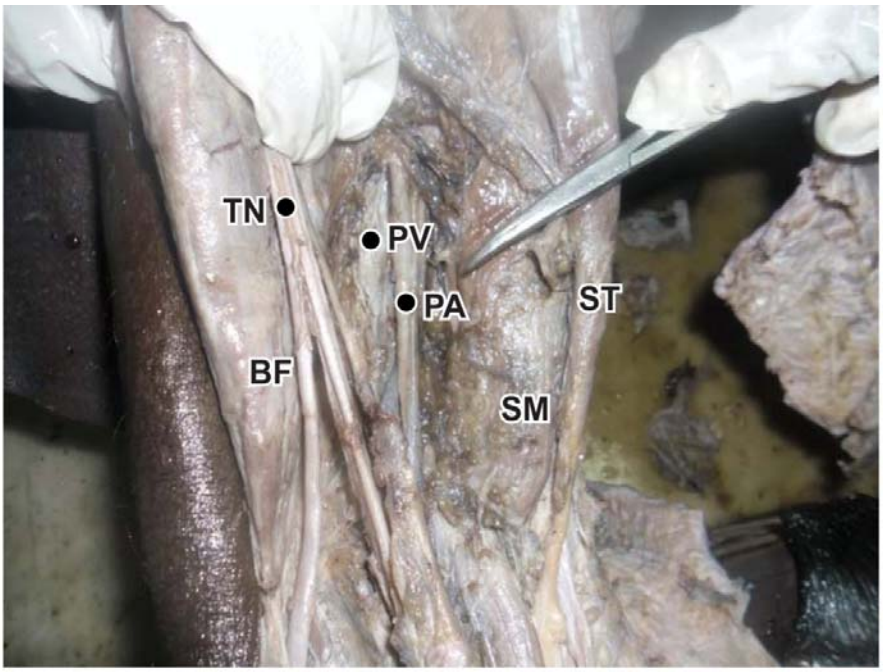

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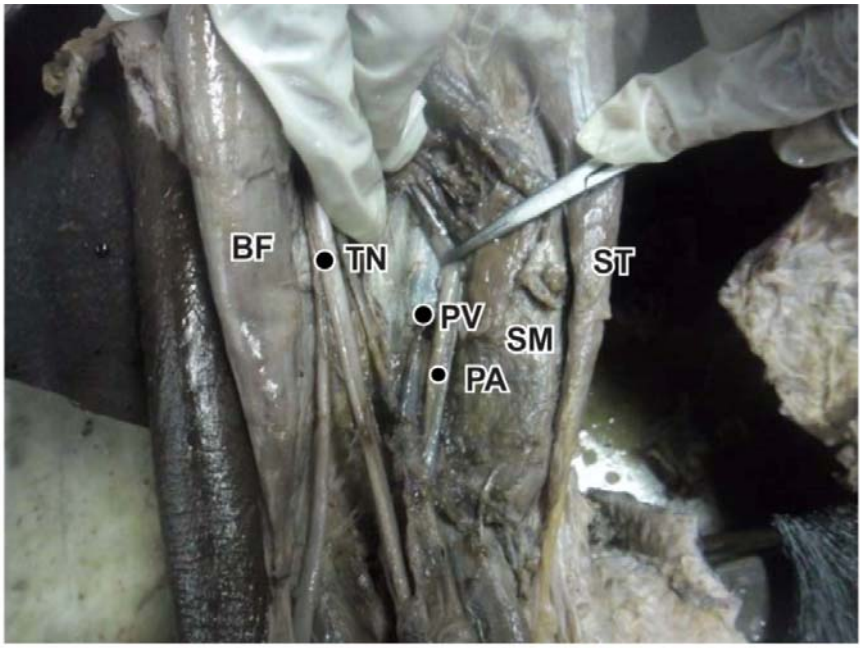

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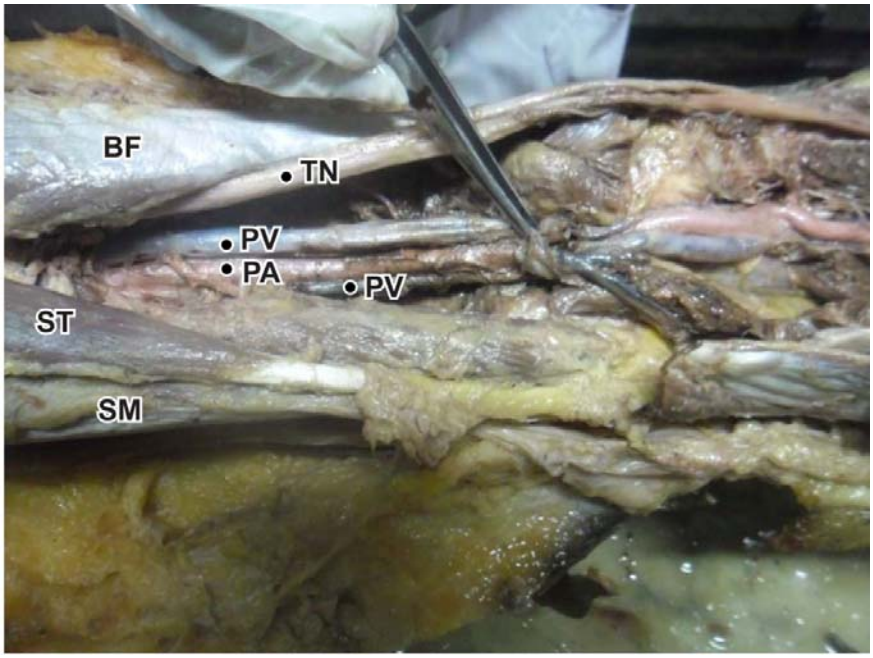

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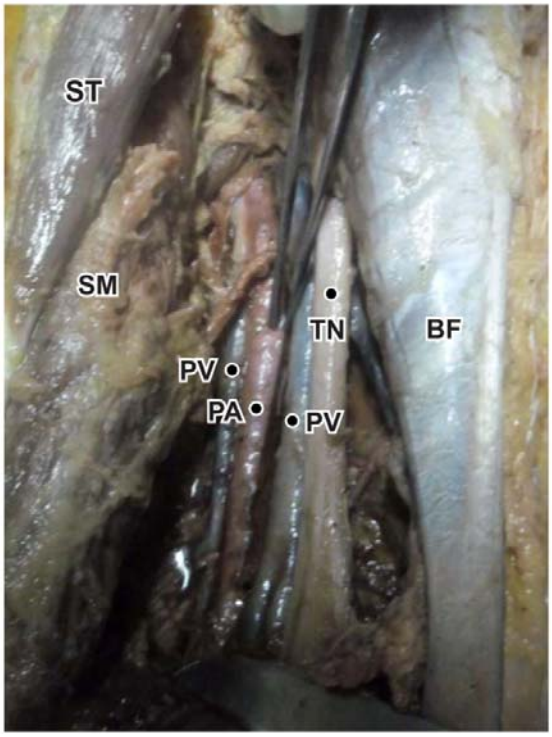

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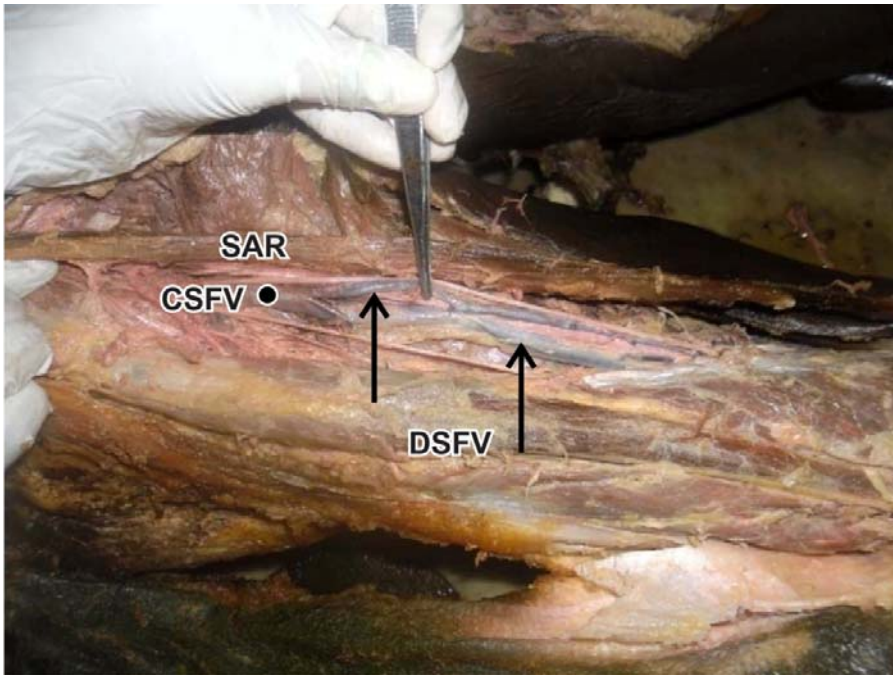

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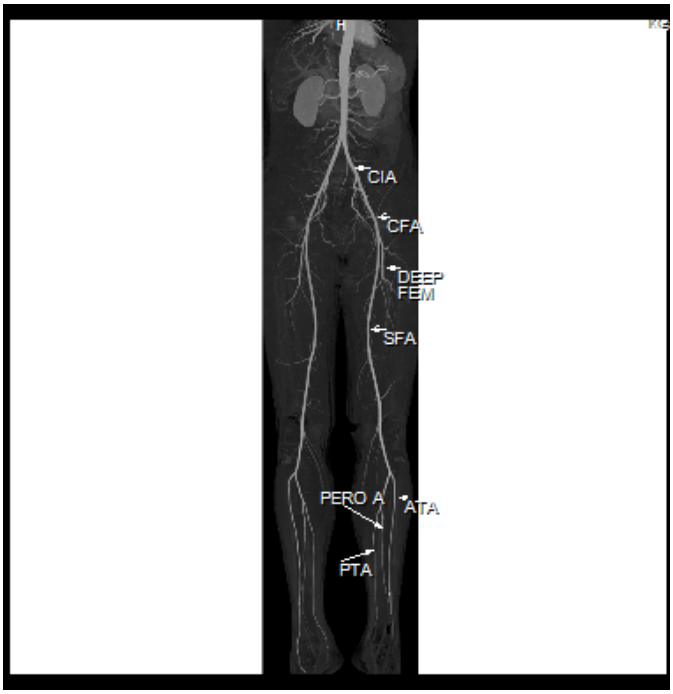
RADIOLOGICAL STUDY



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RADIOLOGICAL STUDY

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BIBILIOGRAPHY

1. Adachi B. Das arterien system der Japaner vol II Kyoto: Maruzwn 1928.

2. Anne.M.R.Agur, Arthur F.Dally (2009),12th edition, Lippincott, Williams and wilkins p-440,402-404

3. Bartsley JL. Stable TW variations in branching of the popliteal artery. Radiology'94;1970;p- 581

4. J.C. Boileau Grant, 1958, 6th edition,Williams and wilkins company, p-420.421.

5. Bouhout sos J.and Martin; A rewiew of 116 cases.Br J Surg;61:469.1974.

6. J.D.Boyd, Legros clark et al, 1956,1st edition St.martin press:p-364-366.

7. Christopher Addison,1905. 12th edition, John murray publishers; p-126-128.

8. Colborn GL et al; Surgical anatomy of popliteal artery. Ann Surgery.1994;Apr:60 (4) p-238-246.

9. Cormack GC, Lamberty BGH:1994. The arterial anatomy of skin flaps. Edinburgh;Churchill livingstone.

10. Cornelius Rose (2006): 5th edition clinically oriented anatomy Lippincott Williams and wilkins; 632-636.

11. Cross L et al; Clinical anatomy of popliteal blood vessels; clinical anat 2000; 13 (5) ;347-353

12. Cunningham's textbook of Anatomy;G .J.Romanes (1964); 12th edition p-938-940.

13. Day CP, orme R, Popliteal artery branching pattern – an angiographic study; clinical radiology; 2006 Aug 61(8):696-699.

14. Ernest Gardner et al; 1963; 2nd edition Saunders company; p- 278,279.

15. Evans; W.E: Popliteal aneurysm.Vascular surgery. 10:86,1976.

16. H.Gaylis (1974); popliteal artery aneurysms- A Review and analysis of 55 cases. S.A. Medical Journal :pp-75-81. .

17. Gray's Anatomy ;Susan Standring: (2012) 40th edition; Elsevier publications. P-138-141.

18. A.Halim (2008); Human Anatomy: vol II. I.K. International Publishing House; p-258-260.

19. D.K.Kadasne (2009): Textbook of anatomy, clinically oriented, 1st edition, Jay pee brothers.p-263-265.

20. Keen.JA.A study of the arterial variations in the limbs with special reference to symmetry of vascular patterns.American Journal of Anatomy.108:1961;p-245-261.

21. Keith L.Moore (2006): Clinically oriented anatomy; 5th edition; Lippincott Williams & wilkins; p- 632-636.

22. Kil Sw, Jung GS: Anatomical Variations of Popliteal artery & its tibial branches; analysis on 1242 Extremities. 2009 march. 32 (2); p-233-240.

23. Kim D, orron DE, SkillmanJJ; Surgical Significance of Popliteal arterial variants. A unified angiographic classification. Ann.Surg. 1989, Dec 210(6); p-776-781.

24. Kropman RH et al, Variations in anatomy of Popliteal artery & its side branches; Vasc.endo vascular surgery. 2011 Aug; 45(6);p-536-540.

25. Kukreja K et al; Role of angiography in Popliteal artery entrapment syndrome. Diagnostic Interventional Radiology.2009 mar.15(1): p-57-60.

26. Last's Anatomy:.Chummy S. Sinnatamby (2006), 12th edition Elsevier publications: p-132-135.

27. Latiff AA, Das.S. Anatomical insight into normal & abnormal branching pattern of Popliteal Artery. Surg.radiol. Anatomy.2009 Aug: 31(7); p-563-564.

28. Lepanto.M.Lindgren-K-A et al. Br.J.Surg. 1989;76; p-1255

29. Leslie Brainerd Arey (1966); Developmental Anatomy, 7th edtion, W.B.Saunders company, p-358,359.

30. Linden Edward (1956); 2nd edition,Concise anatomy, McGraw Hill Book Company. P-227.

31. Lippert H.Papst.R.Arterial variations in man: Classification and frequency. Munchen; J.F.Bergmann veriag, 1985.

32. R.D.Lockhart; Faber & Faber Ltd;1959; 1st edition; p-630-632

33. Mauro mA.et al; Popliteal artery & its side branches; embryologic basis of normal & variant anatomy.AJR Am J Roentgenol. 1988 Feb.50 (2);p-435-437.

34. Mavili E et al; Popliteal artery branching pattern detected by Digital Substraction Angiography. Diagnostic Interventional Radiology.2011 mar 17(1); p-80-83.

35. Morris G C.Buall AC.Berry WB.et al. Anatomical Studies of the distal popliteal artery and its branches. Surg Forum,10: 1961;p-498-502.

36. Morris Stiff G et al.Is assessment of popliteal diameter in patients screening for abdominal aortic aneurysm a worth while procedure. Eur J Vasc Endovasc Surg,2005:30(1):71-4.

37. Neville.RF.Jr et al; Popliteal artery agenesis; new anatomic variant,J Vascular surgery.1990.nov;12(5); p-573-576.

38. Ozgur Z et al; Branching pattern of Popliteal artery & its clinical importance.Surg.Radiol.Anat.2009 Jun:31(5); p-357-362.

39. J.Parsons Schaeffer; 11th edition;1953; Mcgraw Hill Bokk Company; p-733-

40. Poynter C,W.M(1922): Congenital anomalies of the arteries and veins of the human body with bibliography. The University studies of the University of Nebraska 22: 1-106.

41. Quain R (1844);Anatomy of arteries of the human body; Taylor & Walton. p-538-541.

42. Richard.S.Snell (2004); Clinical anatomy, 8th edition, Lippincott Williams & Wilkins, p- 600-604.

43. Ronald A Bergman et al(2001): Illustrated encyclopedia of human anatomic variation: part II; cardio vascular system; Arteries : Lower limb:Femoral artery.

44. Roos.DB.Surgery; 1982; p-1077.

45. Renan uflacker; Atlas of vascular Anatomy (1997); Lippincott Williams & Wilkins;p- 743,744,757,759-761.

46. Russel T.Woodburne: 1961; 2nd edition. Oxford university press; p-546,547.

47. Ruthurford's Vascular Surgery (2010) 7th edition; Elsevier Publications; p-1721-1734.

48. Saha S et al, Department of vascular Surgery,S M J2008 53(4):10.

49. Sahana's Textbook of Anatomy:1956; 1st edition; The Central Book Agency; p-740-742.

50. Sander S RJ. Alston GK Variations & anamolies of Popliteal &Tibial arteries. Am.J.Surg. 1986 nov; 152(5):p-531-534.

51. Scapinelli R. 1968; Studies on Vasculature of human knee joint Anatomy.70;p-305-331.

52. See bacher JR et al; 1982. The Stucture of the posterolateral aspect of the knee.Journal of Bone Joint Surgery.64:p-536-541.

53. Selda yildiz et al: A High origin of Anterior tibial artery and its current clinical importance ;International Journal of Anatomical variations (2010) 3:180-182.

54. Senior HD (1919), The development of the arteries of human lower extremity; Annual Journal of Anatomy; 25; p-55-94.

55. Slaba S et al; Unusual Variation of the Popiteal artery branches; 4 axes by early division of peroneal artery. J.mal.vasc.2007; Dec 32 (4-15):p-212-215.

56. Sir Solly Zukerman , 1961,1st edition, Oxford university press; p-135-137.

57. S Z Pinda.M; Angiographic Pattern of Popliteal Artery in patients with aortailiac occlusive disease.Ann.Anat.2006 Ju.188 (4): p-377-382.

58. Tindall AJ et al; Prevalence & Surgical significance of High origin of Anterior tibial artery.J.orthopaedic surg (Hong kong) 2006; Apr.14(1); p-13-16.

59. Trotter M. The level of termination of the popliteal artery in the white and the negro. Am J phys Anthropol, 27:1940;p-109-118.

60. Warren LF, Marshall JL 1979; The supporting structures & layers on the medial side of the knee; aan anatomical analysis.J.Bone Joint Surg.61 A: p-56-62.

61. Wichulis.A.R; Popliteal aneurysm; Surgery.1970.68: p-942.

62. Zwass.A, Abdul wahab IF A Case report of anomalous branching of popliteal artery. Angiology. 1986;Feb 37(2): p-132-135.

63. Williams PL, Warwick R.Dyson M. Bannister LH.Gray's Anatomy. 38th edition. Churchill Livingstone.

64. Yamada T.Gloviczki.p.Bower T.Naessens JM. Carmichael Sw. Variations of the arterial anatomy of foot. The American Journal of surgery,166;1993:p-130-135.

65. Zehila Kurtoglu, M Haluk Uluutku; A combined variation of the arteries and the nerve in a leg. Tr. J. of Medical Sciences 29(1999) 723-727.

66. Zehila Kurtoglu et al; Two fetuses with popliteal arterial variation , Turk J Med Sci 33(2003) 49-52.

LEGEND

1. PA – Popliteal artery
2. PV – Popliteal vein
3. TN – Tibial nerve
4. ATA – Anterior tibial artery
5. PTA – Posterior tibial artery
6. PER.A – Peroneal artery
7. POP - Popliteus
8. MHG –medial head of gatrocnemius
9. SAR – Sartorius
10. ST – Semitendinosus
11. SM – Semimembranosus
12. BF – Biceps femoris
13. SMB – Superior muscular branches
14. IMB – Inferior muscular branches
15. SMG – Superior medial genicular artery
16. SLG – Superiorlateral genicular artery
17. MG – middle genicular artery
18. IMG – Inferior medial genicular artery
19. ILG – Inferior lateral genicular artery
20. CSFV – common superficial femoral vein
21. DSFV – double superficial femoral vein
22. SAR - sartorius

INTRODUCTION

"Anatomical language is the fundamental language of the medicine"

The basis of anatomy is remarkable for its longivity and consistency . This field has evolved markedly since its inception.

The popliteal artery is the larger peripheral artery situated in the lower limb.It is the only way of arterial communication between the thigh and the leg region.

It is the most common artery to be involved in the peripheral vascular diseases, especially in diabetics and smokers.

So the anatomical study of the popliteal artery will definitively influence the surgical approach and radiological interventional procedures.

The Popliteal artery extends obliquely as a continuation of the femoral artery.It extends from the fifth osseoaponeurotic opening of adductor magnus to lower border of the popliteus. It terminates into anterior and posterior tibial arteries at the lower border of popliteus. This artery is about 20 cm long.

Anteriorly it is related to femoral popliteal surface, capsule of knee joint and fascia of popliteus.

Popliteal vein, tibial nerve ,fascia and skin are related posteriorly.

Superomedially it is related to semimembranosus and semitendinosus.

Superolaterally it is related to biceps femoris.

Inferomedially it is related to medial head of Gastrocnemius.

Inferolaterally it is related to lateral head of gastrocnemius and plataris.

In the upper part of the popliteal fossa, the popliteal artery lies medial to popliteal vein and tibial nerve. In lower part of the popliteal fossa it lies lateral to the popliteal vein and tibial nerve. In the middle of the popliteal fossa, it is crossed from lateral to medial side by popliteal vein and tibial nerve. Throughout the course, the popliteal vein lies between the tibial nerve and the popliteal artery.

The branches of the popliteal artery are

1. Cutaneous branches	:	to the skin over back of the knee.
2 Muscular branches	:	superior muscular branches to hamstring muscles (semimembranosus, semitendinosus and biceps femoris) Inferior muscular branches to soleus, both heads of gastrocnemius and plantaris.
3. Genicular branches	:	superior medial and lateral genicular arteries Middle genicular artery Inferior medial and lateral genicular arteries
4. Terminal branches	:	anterior tibial and posterior tibial arteries [According to Gray's Anatomy: Susan Standring 40th edition-2012]

AIM OF THE STUDY

The popliteal artery is the most common artery to be involved in peripheral arterial aneurysm. 70-80% of peripheral arterial aneurysm occurs in the popliteal artery. Over the last decade, the number of endovascular procedures performed on the superficial femoral and popliteal arteries have significantly increased.

The study of popliteal artery and its branches will be beneficial for the surgical approaches.It also used as suitable arterial graft.

Knowledge of anatomical variation of the popliteal artery is essential for the management of peripheral vascular diseases and orthopaedic surgeries of the lower limbs. Popliteal artery entrapment syndrome (PAES) is a life threatening disease which occurs due to abnormal course of the popliteal artery. In this syndrome the popliteal artery can be entrapped by adjacent muscular structures.

Popliteal artery is a common recipient site for above or below knee bypass grafts. It is also frequently affected by penetrating and blunt trauma involving the lower extremity. The knowledge of origin, branching pattern and variations of the popliteal arterial study helps Surgeons and Orthopaedicians in avoiding unexpected arterial injuries during surgical procedures. It is also helpful for the Radiologists during radiological interventional procedures. With perspect to the above facts, I am very much impressed to study about the popliteal artery and its branching pattern.

The following parameters were used in the present study

1. Origin of the popliteal artery
    a. mode of origin
    b. level of origin
2. Length of the popliteal artery
3. Diameter of the popliteal artery
4. Branches of the popliteal artery
5. Termination of the popliteal artery
6. Relations of the popliteal artery to the adjacent neurovascular structures.

EMBRYOLOGICAL ANATOMY

The lower extremity arterial system arises from two arteries – the axial and external iliac arteries – both of which originates from the umbilical artery.The femoral artery originates from the external iliac artery and progresses distally in the anterior compartment, while the axial artery elongates distally in the posterior compartment.

At this stage of development, around 42 days of intra uterine life, the axial artery is divided into three segments, depending on is relationship to the popliteus muscle (proximal, deep and distal): a bridging artery, the ramus communicans superius, joins the femoral artery and the proximal of the axial artery through the adductor hiatus.During the next week of development, the proximal component of the axial artery gives rise to a branch that runs superficial to the popliteus muscle and joins with the distal segment of the axial artery;the deep segment of the axial artery involutes.The fully developed popliteal artery results from the fusion of several arterial segments.

Initially, both heads of the gastrocnemius muscle originates from the proximal tibia. With development , these migrate craniad along the femur to different extents. The final position of the medial head of gastrocnemius muscle is more proximal to that of the lateral head and immediately caudal to adductor hiatus,with popliteal artery lying immediately lateral. These dynamic processes of muscle and arterial development create the potential for anatomic variations that can result in nonatheromatous popliteal artery abnormalities.

The axis artery of lower limb is derived from fifth lumbar intersegmental artery.In early stages of development, primary umbilical arteries arise from dorsal aorta. The axial artery of the lower limb arises from the dorsal root of the umbilical artery .It courses along the dorsal surfaces of the thigh, knee and leg. Below the knee it lies between the tibia and popliteus .In the leg it lies between the crural interosseus membrane and tibialis posterior. It gives off a perforating artery which traverses the sinal tarsus.

Then the perforating branch form a dorsal network and ends distally in a plantar network. The femoral artery passes along the ventral surface of the thigh .It forms new channel to the lower limb. It arises from a capillary plexus that is connected proximally with the femoral branches of the external iliac artery.Distally the capillary plexus connected with the axis artery.

At the proximal border of the popliteus the axis artery splits into primitive posterior tibial and fibular branches. They run distally on the dorsal surface of popliteus and tibialis posterior muscle.And then posterior tibial artery gain into sole of the foot under flexor retinaculum.

At the distal border of the popliteus the axis artery gives off a perforating branch which passes ventrally between the tibia and fibula.Then it courses to the dorsum of the foot, forming anterior tibial and dorsalis pedis arteries. The primitive fibular artery communicates with the axis artery at the distal border of popliteus. Then it courses in the leg.

The femoral artery gradually increases in size. Coincidentally, most of the axis artery disappears, but proximal to its communication with the femoral artery,The root of the axis artery persists as the inferior gluteal artery and the arteria nervi ischiadici.The proximal parts of the primitive posterior tibial and fibular arteries fuse but they remain separate distally.Ultimately much of the primitive fibular artery disappears; a part of the axis artery is incorporated in the permanent fibular artery. In adults, the remnants of the axis artery are

1. the inferior gluteal artery
2. arteria comitans nervi ischiadici
3. longitudinal anastomosis of the perforating branches of the profunda femoris artery
4. part of the peroneal artery
5. part of the plantar arch.

REVIEW OF LITERATURE

I. ORIGIN OF POPLITEAL ARTERY;

In Cunningham's Manual of Practical Anatomy,**G.J.Romanes** (1996) quoted that the popliteal artery begins at the tendinous opening in adductor magnus. Here it is continuous above with femoral artery.It can also arise as a continuation of inferior gluteal artery.

Henry Hollinshed (1997) : stated that the popliteal artery commences at the adductor hiatus as the continuation of femoral artery.

Neville RF et al (1990) :in their study, they described congenital absence of popliteal artery, discovered during operative exploration after a traumatic injury to the lower extremity.

Keith L. Moore (2006) : quoted that the popliteal artery is the continuation of femoral artery .It begins when the latter passes through the adductor hiatus.

D.K.Kadasne (2009) : stated that the popliteal artery runs as a continuation of femoral artery beyond the opening of artery in adductor magnus.

Richard S. Snell (2010) : the popliteal artery enters popliteal fossa through the opening in the adductor magnus.

Last's Anatomy , **Chummy S.Sinnathamby** (2011) : popliteal artery extends from hiatus in adductor magnus.

In Gray's Anatomy(2012), **Susan Standring** stated that popliteal artery is the continuation of femoral artery. Sometimes it may arise as a continuation of the sciatic artery which is a branch of inferior gluteal artery.

II. LENGTH OF POPLITEAL ARTERY :

H.Gaylis (1974) in his arteriographic study stated that the average length of the popliteal artery was 175 mm.

According to **Zuhal Ozgur** et al (2009) , the length of thepopliteal artery from adductor hiatus to origin of anterior tibial artery was 191.1mm +/- 34.7mm.

According to **A.K.Datta** (2009), the length of popliteal artery was 20 cm.

III. DIAMETER OF THE POPLITEAL ARTERY :

In a ultrasonic study **Crawford** et al(1998),found that the mean popliteal artery diameter was 7.2mm and 6.1mm in male and female respectively.

Morris et al(2005) in a duplex study found that the mean popliteal artery diameter was 7.4mm +/- 1.1mm.

According **to Wolf YG** (2006) , the mean popliteal artery diameter was 7.4mm +/-0.8mm.

In a cadaveric study **Ozgur Z** (2009) found that the mean popliteal arterial diameter was 7.5 +/-1.3mm.

Selda Yildiz et al(2010) in his study said that the mean popliteal artery was 8.3mm.

IV. BRANCHES OF POPLITEAL ARTERY :

According to **Cunningham** (1996) :the branches of popliteal artery are

- branches to hamstring muscles
- to muscles of the calf

(larger two arteries are called sural arteries)

- five genicular branches: superior medial and lateral genicular arteries

middle genicular artery

Inferior medial and lateral genicular arteries.

Henry Hollinshed (1997) :

- The popliteal artery gives five genicular branches and muscular branches to muscles of popliteal fossa.

Keith (L) Moore (2006)

- Genicular and muscular branches

D.K.Kadasne : (2009)

- stated that the popliteal artery gives rise to cutaneous branches, genicular branches and muscular branches.

Gray's Anatomy :Susan Standring (2012)

- Five genicular branches
- Superior muscular branches : to adductor magnus and hamstrings
- Inferior muscular branches : sural arteries are two in number and supply gastrocnemius, soleus and plantaris.

  (they are used in gastrocnemius musculocutaneous flap)
- Cutaneous : the superficial sural arteries.

  (fascio cutaneous free and pedicled flaps may be raised on the superficial sural arteries)

Zuhal Ozgur (2009) in his cadaveric study,found that the inferior lateral genicular artery arose from anterior tibial artery. The inferior medial genicular artery arose from common tibioperoneal trunk in a case.

IV. TERMINATION OF POPLITEAL ARTERY

In **Ducksoo Kim** et al, described surgical importance of popliteal artery variations – he classified popliteal artery branching into 3 types :

1. Normal level of popliteal arterial termination :

   Type 1 A : normal pattern ; Anterior tibial artery arises first , common tibioperoneal trunk branches into peroneal and posterior tibial arteries.

   Type 1 B : Trifurcation pattern :The popliteal artery branches into anterior tibial,posterior tibial and fibular arteries. The tibioperoneal trunk is absent.

   Type 1 C : Posterior tibial artery is the first branch – common tibioperoneal trunk divides into anterior tibial and fibular arteries.

2. High level of termination of Popliteal Artery :

   Type II A: Anterior tibial artery originates at or proximal to the knee joint

   1. Normal course of proximal anterior tibial artery
   2. Medial initial curve in anterior tibial artery

   Type II B : Posterior tibial artery arises at or proximal to the knee joint. Common stem for peroneal artery and anterior tibial artery.

Type II C: Fibular artery arises at or proximal to the knee joint. Anterior and posterior tibial arteries arise from a common stem.

3. Hypoplastic or aplastic branching with Altered Distal Supply :

Type III A : Hypoplastic-aplastic posterior tibial artery. Distal posterior tibial artery is replaced by fibular artery.

Type III B : Hypoplastic-aplastic posterior and anterior tibial arteries.Dorsalis pedis artery is replaced by fibular artery.

Type III C : Hypoplastic-aplastic posterior and anterior tibial arteries. Dorsalis pedis artery is replaced by fibular artery.

Kim D et al (1989) : in his angiographic study of 605 extremities, described

92.2% - Normal pattern- Type I A

5.6% - High level origin of anterior tibial artery- Type II A

2.2% - Trifurcation pattern- Type I B

G.J.Romanes (1996) : stated that the popliteal artery ends at the inferior border of the popliteus and there it divides into anterior tibial and posterior tibial arteries.

Cornelius Rosse, Penelope Gaddum Rosse (1997) :

Stated that the popliteal artery ends by dividing into anterior tibial and posterior tibial arteries at the inferior border of popliteus.

Keith L. Moore (2006):

Described that the popliteal artery ends at the lower border of popliteus by Terminating into anterior and posterior tibial arteries.

Slaba S et al (2007) described an unusual variation of popliteal arterial branches , where the popliteal artery divides into 4 axes by early division of peroneal artery.

Sanders RJ, Alston GK (1986) in their angiographic study in 147 patients(294 limbs).

97% - Normal pattern Type I A

3% - High origin of posterior tibial artery- Type II B

Zwass A, Abdel wahab IF (1986) : presented a rare embryological anomaly,in which posterior tibial artery was found with hypoplastic anterior tibial artery. In this case , marked hypertrophy of fibular artery also noted.

Tindall AJ (2006) : in his angiographic study in 100 knees

94% - Normal pattern -Type I A

6% - High origin of anterior tibial artery-Type IIA.

S Z pinda .M (2006)

In his angiographic study in 152 limbs of Leriche syndrome patients

87.5% - Normal branching -Type I A

2.63% -Trifurcation - Type I B

1.97% - posterior tibial artery is the first branch-

common anterior tibiofibular trunk-Type I C

1.98% -High level of origin of anterior tibial artery-Type II A

5.92% - High level of origin of posterior tibial artery -Type II B

Day CP Orme R : 2006

1037 limbs (angiographic study)

90.7% - Normal pattern-Type I A

4.5% - High level of origin of anterior tibial artery -Type II A

3.2% - Trifurcation pattern -Type I B

1.1% - High level of origin of posterior tibial artery-Type II B

0.2% - High origin of fibular artery- Type II C

0.3% - Both anterior tibial and posterior tibial arteries are rudiment -Type III C.

Ozgur Z et al (2009) : cadaveric study of 40 lower limbs.

90% - Normal patternType I A

5% - High level of origin of anterior tibial artery- Type II A

2.5% - Trifurcation pattern - Type I B

2.5%- High level of origin of posterior tibial artery- Type II B

Anne M R Agur, Arthur F Dallay (2009) : stated that absence of posterior tibial artery, compensatory enlargement of fibular artery occurs in 5% limbs. And high division of popliteal artery in 2% of limbs.

Kil SW, Jung GS : 2009

1242 limbs : angiographic study

89.2% - Normal pattern - Type I A

5.1% - Hypoplastic posterior tibial artery and large fibular artery-Type III A

1.7% - Hypoplastic anterior tibial artery and large fibular artery- Type III B

1.5% - Trifurcation pattern Type I B

1.2% - High level of origin of anterior tibial artery-Type II A

0.8% - Both anterior tibial and posterior tibial arteries are rudimentery -Type III C

0.4% - High origin of posterior tibial artery- Type II B

0.1% - Posterior tibial artery is the first branch;common tibioperoneal trunk- Type I C

Mavili E et al (2011)

Angiographic study of 535 limbs.

88.1% - Normal pattern - Type I A

5.6% - High origin of anterior tibial artery-Type II A

6.1% - Both anterior tibial and posterior tibial arteries are rudimentary –Type III C

0% - High origin of peroneal artery-Type II C

0.2% - Type II D

[Ty II D : new pattern : High division of fibular artery with a trifurcation and anterior tibial artery with above medial course and below lateral course.]

Kropman et al (2011)

In cadaveric study of 7671 limbs.

90% - Normal pattern-Type I A

7% - Trifurcation -Type I B

1% - Hypoplastic posterior tibial artery and large fibular artery-Type III A

2% - High level of origin of anterior tibial artery-Type II A

Susan Standring (2012) : popliteal artery divides at distal border of popliteus

90% - Normal pattern

5% - High bifurcation or it may trifurcates.

VI. RELATION OF POPLITEAL ARTERY TO POPLITEAL VEIN AND TIBIAL NERVE:

G.J.Romanes (1996) : from above downwards the popliteal artery is superficial to semimembranosus, the popliteal vein, tibial nerve and gastrocnemius with plantaris.

Cornelius Rosse and Penelope Gaddum Rosse (1997): deeper in the popliteal fossa is the popliteal artery. The popliteal vein is directly back to it and tibial nerve is back to the vein.

Arthur F Dalley (2006):

The popliteal vein lying superficial to the popliteal artery and in the same fibrous sheath.

A.Halim (2008):

Tibial nerve and popliteal vein lies superficial to the popliteal artery. The tibial nerve crosses the popliteal vessels from lateral to medial side as it courses downwards.

D.K. Kadasne (2009):

The popliteal vein follow the artery but lies superficial to it and the tibial nerve lies superficial to artery and vein.

Anne M.R.Agur, Arthur F Dalley (2009):

The tibial nerve is superficial to the popliteal vein , which in turn is superficial to the artery.

Richard S. Snell (2010):

Tibial nerve crosses the popliteal artery from lateral to medial side. The popliteal vein lies superficial to the popliteal artery.

Chummy S. Sinnatamby : 2011

Throughout the popliteal fossa, the popliteal artery is deepest of large neurovascular structures in the popliteal fossa. At all levels popliteal vein lies between the artery and nerve.

Susan Standring- Gray'sAnatomy:2012

Popliteal artery crossed from its lateral to medial side by tibial nerve and popliteal vein. The popliteal vein lies between tibial nerve and popliteal artery. The popliteal vein is usually superficial and adjacent to the popliteal artery. The vein may be separated from the artery by a slip of muscle derived from the medial head of gastrocnemius.

DOUBLE POPLITEAL VEIN :

Poynter (1922) :in his study found 40% of cases with double popliteal vein. In a study done by **E.Dona** et al(2000) 18 % of cases shown double popliteal vein with double superficial femoral vein.

Daniel J. Quinlan (2002) found double popliteal vein in 5% of the cases.

FOETAL STUDY:

Zehila Kurtoglu (2003) presented two foetal cadavers in a case report.In that popliteal artery divided into posterior tibial artery and anterior tibioperoneal trunk.This variation fits into TypeII B pattern of Ducksoo Kim's classification.

* In the right lower extremity of the first foetus , the popliteal artery divided into posterior tibial artery and anterior tibioperoneal trunk .The division occurred above the lower border of popliteus.

* In left lower extremity of the first foetus also the popliteal artery divided into posterior tibial artery and anterior tibioperoneal trunk above the lower border of popliteus.

* In the left lower limb of the second foetus, the popliteal artery divided into posterior tibial artery and anterior tibioperoneal artery .The division was proximal to lower border of popliteus muscle.

* The right lower limb of the second foetus followed the normal pattern.

MATERIALS AND METHODS

MATERIALS USED IN THIS STUDY :

i. 30 lower limb specimens obtained from 9 male cadavers and 6 female cadavers from The Govt. Stanley Medical College, Department of Anatomy, Chennai-01.

ii. 10 lower limb specimens from-5 full term unclaimed foetal cadavers(3 male foetal cadavers and 2 female foetal cadavers)were obtained from the Department of Obstetrics and Gynaecology, Govt. R.S.R.M. Hospital,Chennai-01.

iii. 10 Computerised Tomographic lower limb angiogram from patients who underwent angiographic procedures in the Department of Radiology, Stanley Medical College,Chennai -01.

METHODOLOGY;

a. **Dissection** – In adult and foetal cadavers

b**. Radiological study** - In five patients who underwent lower limb angiography.

METHODS

A.DISSECTION METHOD :

ADULT SPECIMENS :

The dissection was carried out according to the methodology given by Cunningham's Manual of Practical Anatomy. A longitudinal skin incision on the back of mid point of thigh to heel was made. Skin and superficial fascia were reflected. A cut was made through the deep fascia along the biceps femoris and the muscle was exposed along with its tendon to the insertion. And similar incision was made over semimembranosus and semitendinosus and two muscles were exposed; gracilis and its tendon also exposed. Deep fascia from the posterior surface of the politeal fossa was removed and the tibial nerve was exposed.

The two bellies of gastrocnemius were identified and separated from their attachments. The popliteal artery was exposed.Then the muscular branches were noted.The soleus was separated from the tibial attachment and lower border of popliteus was identified. The fascia over the lower part of popliteal vessels was removed and the terminal branches (anterior and posterior tibial arteries) were exposed.

During this dissection, tibial nerve was medial to popliteal artery in the upper part of the popliteal fossa.Then the nerve crosses the artery superficially.The tibial nerve was on the lateral side of the artery in the middle and lower part of popliteal fossa. During the above procedure it was noted that the popliteal artery begins at the osseoaponeurotic opening in the adductor magnus muscle and was continuous above with femoral artery.

The branching pattern, mode of termination and level of termination of the popliteal artery were also noted. The length and diameter of the popliteal artery were also measured.

FOETAL SPECIMENS:

The dissection method followed in foetal cadavers was similar to the dissection in adult method.The origin, branching pattern and termination were identified and noted down for the present study. The relation of the popliteal artery to popliteal vein and to the tibial nerve was also observed.

B. RADIOLOGICAL STUDY

(164 Multislide detector computerised tomographic angiography):

Computerised Tomographic lower limb angiogram images of five patients, who underwent this procedure in the Department of Radiology, Stanley Medical College, Chennai 01 were selected without disclosing their names.The patients were selected for the study, after getting ethical committee clearance and proper written consent.

For the above patients, lower limb Computerised Tomographic angiography was done. The popliteal artery was photographed and studied. The latest generation of Computerised Tomography has the ability to capture very thin slices of tissue under study with a gap interval of 0.001mm distance between each slice and has the ability to spontaneously reconstruct the images. The multiple ComputerisedTomographic X- ray tubes oscillate 164 times in one minute and capture the image in a sequence.

It was very useful to study angiography of large vessels, its major branches and its variations. A 3 D reconstructed image of vessel under study was obtained in coronal, sagittal and transverse plane.

RADIOLOGICAL PROCEDURE :

Patient was made to lie down on the couch of computerised tomographic gantry and limb under study was extended within the perview of Computerised Tomography X ray oscillation.Cephalic vein was cannulated with a venflon and contrast agent Omniphage, a third generation water soluble iodinated contrast was infused through a injector at a rate of 2mg/kg and a series of images were captured within seven minutes of administration for arterial phase and within 5 minutes for venous phase.From the computerised tomographic series of images , the origin, branching pattern and termination of the popliteal artery were studied.

OBSERVATION

The origin,length, diameter,branching pattern, termination and relations of the popliteal artery were studied by

A.Dissection method : In adult and foetal cadavers

B.Radiological study : From lower limb Computerised Tomographic angiograms

The observations were summarized in accordance with the parameters taken for the study.

A. DISSECTION METHOD

I.ORIGIN OF POPLITEAL ARTERY :

a. Mode of origin :

In present study, in all cases(30 adult specimens and 10 foetal specimens) the popliteal artery arose as a continuation of femoral artery(PICTURE 1&3) . The occurrence of origin of popliteal artery from femoral artery in adult and foetal specimens were 100%.(Table 1-OB)

(i) MODE OF ORIGIN
TABLE1 (OB)

S.No	Mode of origin	Adult [30 specimens]		Foetal [10 specimens]	
		Number	%	Number	%
1.	As a continuation of femoral artery	30	100	10	100
2.	Other modes of origin	-	-		-

I.ORIGIN OF POPLITEAL ARTERY :

b.Level of origin:

In present study in all cases (30 adult specimens and 10 foetal specimens) the popliteal artery arose at the adductor hiatus (PICTURE 1&3). The occurrence of level of origin at adductor hiatus is 100% in both adult and foetal specimens.(Table 2-OB) .

(ii) **LEVEL OF ORIGIN**

TABLE 2 (OB)

S.No	Level of origin	Adult [30 specimens]		Foetal [10 specimens]	
		Number	**%**	**Number**	**%**
1.	In relation to fifth osseo-aponeurotic opening in the adductor magnus	30	100	10	100
2.	High level of origin	-	-	-	-
3.	Low level of origin	-	-	-	-

II. LENGTH OF POPLITEAL ARTERY :

The length of popliteal artery was measured (in centimeters) from the fifth osseoaponeurotic adductor opening to the level of bifurcation, using measuring scale in all the specimens(PICTURE 4).

*In the present study the average length of the popliteal artery in adult cadaver was 17.35 cm.(Table 3-OB)

II.LENGTH OF THE POPLITEAL ARTERY : IN ADULT
TABLE 3 (OB)

S.No	Adult specimens [30] (Length in centimeters)	
	Right	**Left**
1.	17	17.5
2.	18	18
3.	17.5	17.8
4.	16.8	16.5
5.	18	18.3
6.	19	19
7.	17.5	17.5
8.	18.5	18
9.	16	16
10.	17	17.5
11.	18	18
12.	16.5	16
13.	16	17
14.	12.8	17
15.	18.5	18.3
Total	257.1	263.4

Average length of the popliteal artery = 17.35 centimeters.

III . DIAMETER OF THE POPLITEAL ARTERY :

The diameter was measured using standard caliper (vernier caliper) and studied in millimeters(PICTURE 5&6).

Diameter of popliteal Artery = External diameter - Wall thickness

*The average diameter of the popliteal artery in adult cadaver in the present study = 7.67 mm.(Table 4-OB)

III.DIAMETER OF POPLITEAL ARTERY IN ADULT CADAVER:

TABLE- 4 (OB)

S.No	Adult [30 specimens] Diameter (in mm)	
	Right	Left
1.	7.5	7.6
2.	7.2	7.3
3.	8.0	7.8
4.	6.8	7.0
5.	7.6	7.4
6.	8.4	8.6
7.	7.4	7.2
8.	7.2	7.3
9.	8.0	8.2
10.	7.9	7.8
11.	7.7	7.4
12.	7.2	7.2
13.	8.4	8.3
14.	8.6	8.6
15.	7.4	7.2
Total	115.3	114.9

The average diameter of the popliteal artery =7.67 millimeters .

IV. **BRANCHES OF THE POPLITEAL ARTERY :**

In my study in 29 limbs :

1. Muscular branches to muscles of the popliteal region were observed. They arose as superior and inferior muscular branches(PICTURE 7).
2. Genicular branches were observed.They arose as superior, middle and inferior genicular branches.
3. One or two cutaneous branches were also observed.

In one specimen alone inferior lateral genicular artery arose from anterior tibial artery.

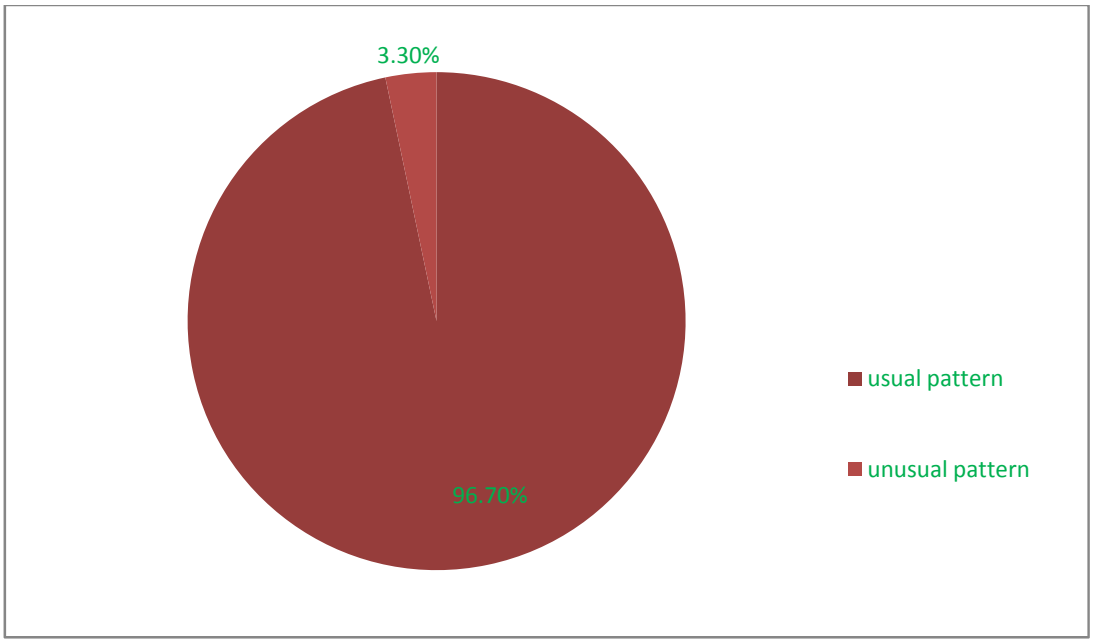
The inferior medial genicular artery arose from common tibioperoneal trunk.(PICTURE 8)

- The occurrence of branching type of popliteal artery were usual in 29 adult specimens (96.7%).
- The unusual origin of inferior lateral and medial genicular arteries from anterior tibial and tibioperoneal arteries respectively was observed in one specimen(3.3%).(Table 5-OB ,Chart 1-OB)

IV.BRANCHES OF THE POPLITEAL ARTERY
TABLE -5 (OB)

S.No	**Branches of popliteal artery**	**Adult [30 specimens]**	
		Number	**%**
1.	Usual pattern from popliteal artery	29	96.7
2.	Unusual origin of inferior lateral and medial genicular branches from anterior tibial artery and tibioperoneal trunk	1	3.3

IV. BRANCHES OF POPLITEAL ARTERY WITHIN POPLITEAL FOSSA
CHART 1-OB



V.TERMINATION OF THE POPLITEAL ARTERY :

IN ADULT SPECIMENS:

- In the present study,27 specimens (90%) followed the Type IA pattern - Termination of anterior tibial and posterior tibial arteries at the inferior border of popliteus.(PICTURE 9).

- In 2 specimens (6.7%) it followed the Type IB pattern- Trifurcation of popliteal artery into anterior,posterior and peroneal arteries at the lower border of popliteus. (PICTURE 10&11).

- In one specimen (3.3%) it followed the Type IIA pattern-High origin of anterior tibial artery proximal to lower border of popliteus.(Table 6-OB ,Chart 2-OB, PICTURE 12).

V.TERMINATION OF THE POPLITEAL ARTERY : IN ADULT CADAVERS

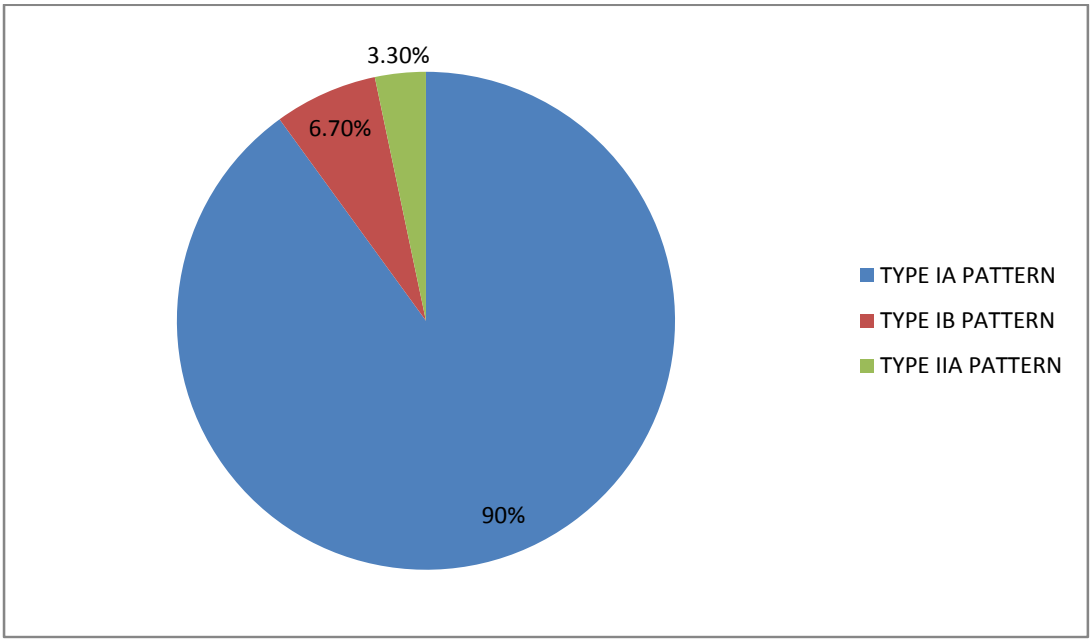
TABLE -6 (OB)

(According to Ducksoo Kim's Classification)

S.No	Type of branching	Adult [30 specimens]	
		Number	%
1.	Type I A	27	90
2.	I B	2	6.7
3.	I C	-	-
4.	TypeII A	1	3.3
5.	II B	-	-
6.	IIC	-	-
7.	TYPE III A	-	-
8.	III B	-	-
9.	III C	-	-

INCIDENCE OF TERMINATION OF POPLITEAL ARTERY IN ADULT CADAVERS

CHART 2- OB



V. TERMINATION OF POPLITEAL ARTERY :

IN FOETAL SPECIMENS:

- In 8 specimens (80%) it followed the Type IA pattern-Bifurcation into anterior and posterior tibial arteries.
- In 1 specimen(10%) it was a Type IB pattern- trifurcation pattern (PICTURE 13)
- In 1 specimen (10%) there was high origin of posterior tibial artery proximal to lower border of popliteus- Type IIB pattern.(Table 7- OB, Chart 3- OB,PICTURE 14).

V.TERMINATION OF THE POPLITEAL ARTERY :IN FOETAL CADAVERS

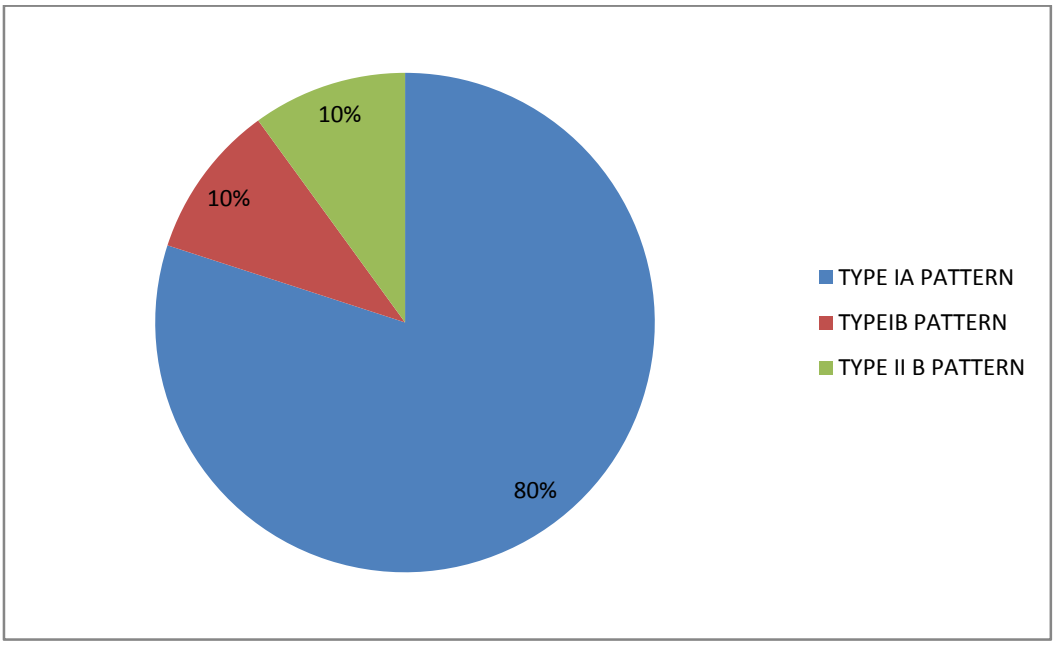
TABLE -7 (OB)

(According to Ducksoo Kim's Classification)

S.No	Type of branching	Foetus [10 specimens]	
		Number	%
1.	Type I A	8	80
2.	I B	1	10
3.	I C	-	-
4.	TypeII A	-	-
5.	II B	1	10
6.	IIC	-	-
7.	TYPE III A	-	-
8.	III B	-	-
9.	III C	-	-

V. INCIDENCE OF TERMINATION OF POPLITEAL ARTERY IN FETAL CADAVERS

CHART 3-OB



VI.RELATION OF POPLITEAL ARTERY TO POPLITEAL VEIN AND TIBIAL NERVE :

ADULT SPECIMENS:

In the present study, in 29 specimens (96.7%) the popliteal artery passed deep to popliteal vein and tibial nerve(PICTURE 15)

. In one specimen (3.3%) the popliteal artery passed superficial to popliteal vein but deep to tibial nerve. (TABLE 8 OB, CHART 4-OB, PICTURE 17& 18).

IN FOETAL SPECIMENS :

In all specimens (100%) the popliteal artery followed the normal relation that it passed deep to popliteal vein and tibial nerve.(PICTURE 16).

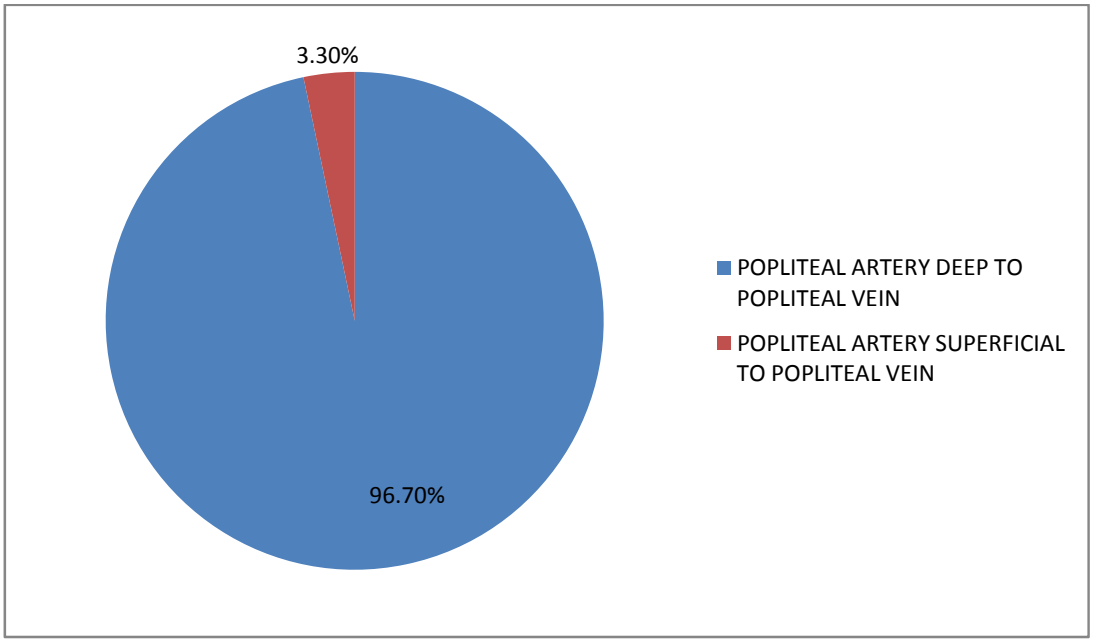
VI.RELATION OF POPLITEAL ARTERY TO POPLITEAL VEIN AND TIBIAL NERVE

TABLE -8 (OB)

S.No	Relation of popliteal artery to adjacent structures	Adult [30 specimens]		Foetal [10specimens]	
		Number	%	Number	%
1.	Popliteal artery deep to popliteal vein &tibial nerve	29	96.7	10	100
2.	Popliteal artery superficial to popliteal vein	1	3.3	-	-

VI .RELATION OF POPLITEAL ARTERY TO POPLITEAL VEIN AND TIBIAL NERVE

CHART 4- OB



A RARE VARIANT :

Presence of double popliteal vein.

Out of the 30 lower limb specimens in one specimen(right),the popliteal artery was accompanied by double popliteal vein which arose by non fusion of anterior and posterior tibial veins.(PICTURES 19&20).

The double popliteal vein continued above as double superficial femoral vein which subsequently form a single vein in the femoral triangle about 6 cm below the inguinal ligament.(PICTURE 21).

*The occurrence of double popliteal vein in the present study was 3.3%.

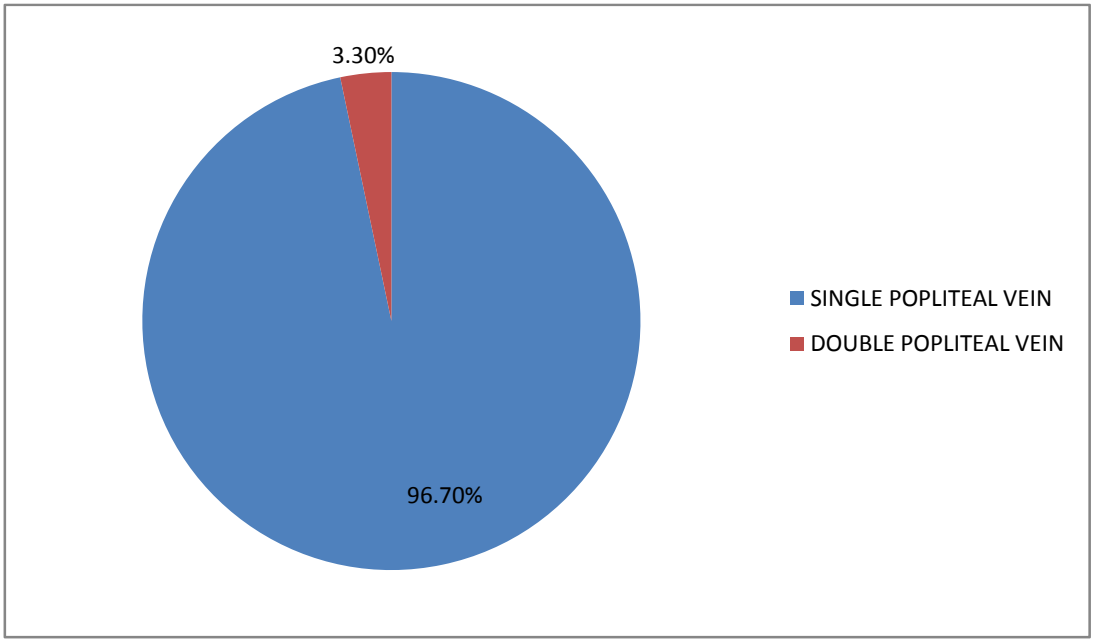
(TABLE 9 OB, CHART 5- OB)

A RARE VARIATION : DOUBLE POPLITEAL VEIN WITH DOUBLE SUPERFICIAL FEMORAL VEIN

TABLE-9 (OB)

S.No	Presence of double popliteal veins	Adult (30 specimens)	
		Number	%
1.	Single popliteal vein	29	96.7
2.	Double popliteal vein accompanying popliteal artery	1	3.3

INCIDENCE OF DOUBLE POPLITEAL VEIN
CHART 5 OB



B. RADIOLOGICAL STUDY :

(Using 164 multislice detectors computerised tomographic angiograms)

Out of the 10 images studied , 9 images were followed normal pattern that is termination of popliteal artery into anterior and posterior tibial arteries.And only one image shown trifurcation pattern.(picture 22 &23).

The incidence of variation in the branching pattern of popliteal artery (trifurcation pattern) was observed in 10% of the cases.

DISCUSSION

The variations in the origin,length, diameter, branching pattern,relation and termination of popliteal artery were analyzed and compared with those described previously by several researchers.

I.ORIGIN OF POPLITEAL ARTERY :

Henry Hollinshed (1958),Keith.L.Moore(2006) , Richard . S.Snell (2010) described that the popliteal artery commences at the adductor hiatus as a continuation of femoral artery. G.J.Romanes(1996) quoted that the popliteal artery continue above as femoral artery.He also stated that it can also arise as a continuation of inferior gluteal artery. According to Susan Standring (2012), it may originates as a continuation not of the femoral artery but of sciatic artery which is abranch of inferior gluteal artery.

In the present study in all specimens (100%) ,the mode and level of origin of popliteal artery followed the usual pattern that is as a continuation of femoral artery. In the present study, no variation was observed regarding the origin of the popliteal artery.

II. LENGTH OF THE POPLITEAL ARTERY :

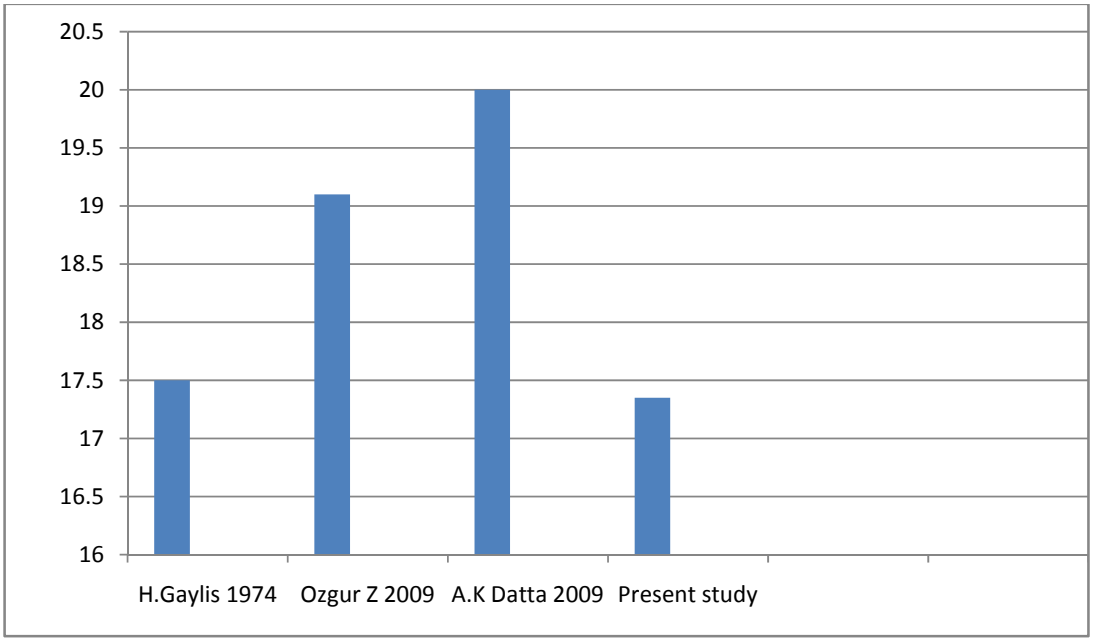
H.Gaylis (1974) in his arteriographic study in 55 cases, stated that the average length of popliteal artery was 175mm.

In a cadaveric study done by Zuhal Ozgur et al(2009), the length of popliteal artery were recorded in 40 limbs.The average length of popliteal artery from adductor opening to origin of anterior tibial artery in his study was 191.1 +/- 34.7 mm.

According to Asim Kumar Datta (2009) ,the length ofpopliteal artery was 200 millimeters.

In the my study the average length of the popliteal artery was 173.5mm. It coincides with values of H.Gaylis.(CHART 1- D)

LENGTH (IN CENTIMETERS) OF THE POPLITEAL ARTERY
CHART -1 D



III. DIAMETER OF POPLITEAL ARTERY :

According to Zuhal Ozgur etal (2009), the mean diameter of popliteal artery was 7.5mm +/- 1.3mm.

According to Morris et al (2005) ,mean diameter was 7.4 +/- 1.1mm

Crawford M et al(1998) studied popliteal artery diameter.It was 7.2mm in male and 6.1 mm in female.

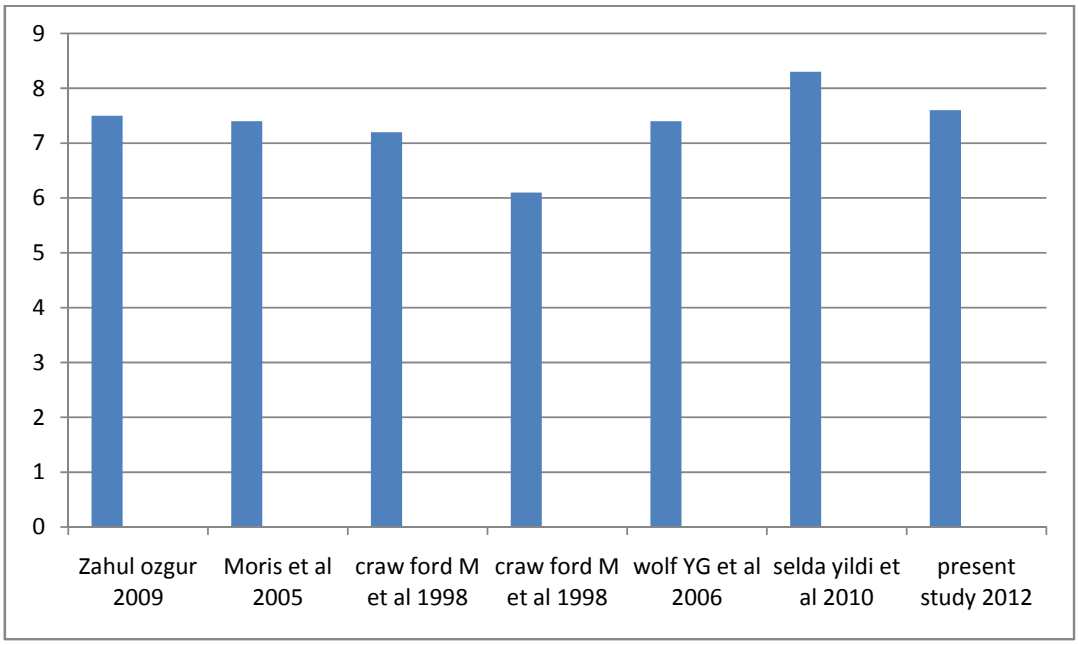
According to Wolf YG et al (2006) the mean popliteal artery was 7.4mm +/- 0.8mm.

According to Selda yildiz et al (2010) the popliteal artery diameter was 8.3mm.

In the present study ,the average diameter of the poplitael artery was 7.6mm.

It approximately coincides with studies done by Zuhal Ozgur, Morris, Crawford and Wolf YG**. (CHART 2- D)**

DIAMETER (IN MILLIMETERS) OF POPLITEAL ARTERY
CHART -2 D



IV.BRANCHES OF POPLITEAL ARTERY:

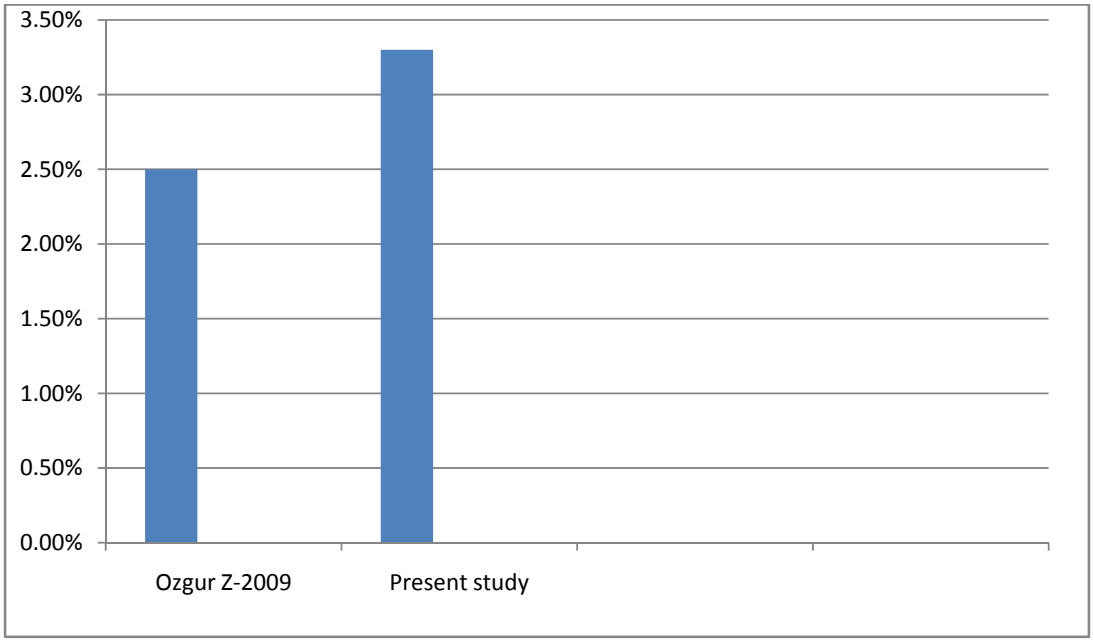
According to Cunningham(1996), Keith L Moore(2006), Henry Hollinshed(1997) and Gray (2012) the popliteal artery gives origin to 3-4 muscular branches to hamstring muscles , 2-3 inferior muscular branches to muscles of the calf, 5 genicular branches and 1 or 2 cutaneuos branches. According to Zuhal Ozgur et al (2009),in a cadaveric study in 40 lower limbs, in one specimen (2.5%) the inferior lateral genicular artery arose from anterior tibial artery and the inferior medial genicular artery arose from common tibioperoneal trunk.

In the present study, in 29 specimens (96.7%) the popliteal artery shown the usual branching pattern within the popliteal fossa. In one specimen (3.3%) the inferior lateral genicular artery arose from the anterior tibial artery and inferior medi al genicular artery arose from common tibioperoneal trunk. (CHART 3- D).

This incidence of unusual origin was more than the incidence stated by Zuhal Ozgur.

UNUSUAL ORIGIN OF INFERIOR MEDIAL AND LATERAL GENICULAR ARTERIES

CHART 3- D:



V. TERMINATION OF POPLITEAL ARTERY AT LOWER BORDER OF POPLITEUS : NORMAL PATTERN-TYPE I A

In a angiographic study done by Kim D et al(1989), the Type IA – normal pattern was observed in 92.2% of the cases.

According to Sanders RJ, Alston GK (1986), the occurrence of normal pattern was seen in 97% of the cases.

According to Day CP (2006), Ozgur Z(2009),Kropman (2011) the occurence of TypeIA were 90.7%, 90% and 90% respectively.

In studies done by S Z Pinda(2006),Kil SW(2009), Mavili E(2011) the incidence of Type I A pattern were 87.5%, 89.2% and 88.1% respectively.

Tindall J (2006) noted Type IA pattern in 94 % of cases.

In the present study, the occurrence of Type IA (normal type) was observed in 90 % of the limbs.

*It coincides with the studies done by Day CP,Ozgur and Kropman et al.

*it was less than the incidence quoted by Sanders RJ,Kim D and Tindall AJ.

*it was more than the incidence studied by SZ Pinda,Kil SW and Mavili et al.

(Table 1D, Chart 4D)

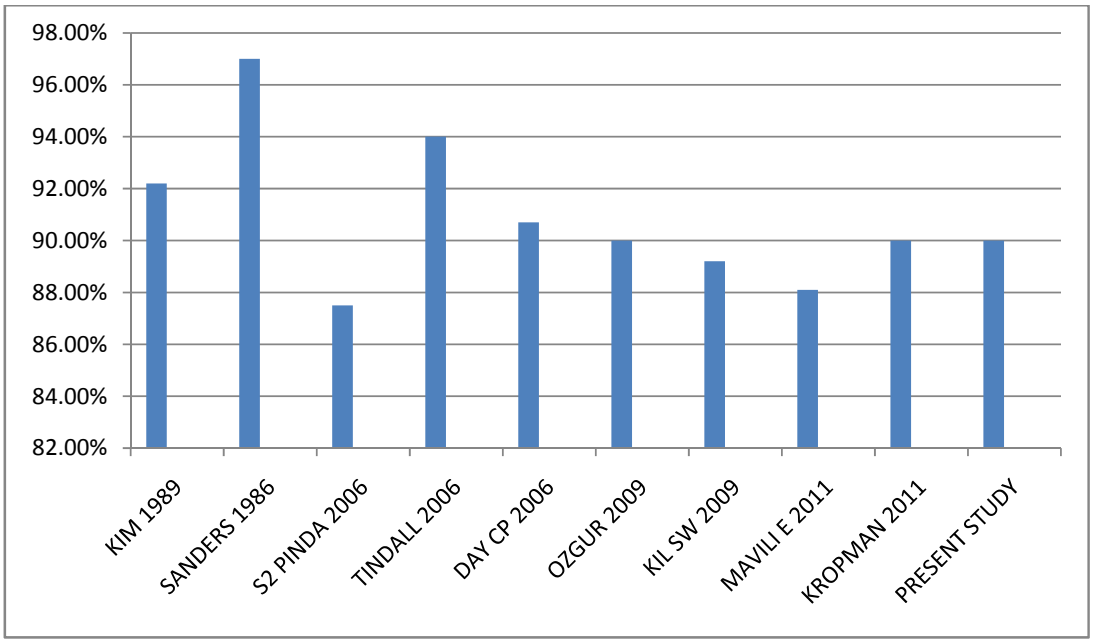
V.TERMINATION OF POPLITEAL ARTERY

NORMAL PATTERN : TYPE IA PATTERN
TABLE :1(D)

S.NO	STUDIES	INCIDENCE
1	Sanders (1986)	97%
2.	Kim D et al (1989)	92.2%
3.	Day C P (2006)	90.7%
4.	S Z Pinda (2006)	87.5%
5.	Tindall J (2006)	94%
6.	Kil S W(2009)	89.2%
7.	Ozgur Z(2009)	90%
8.	Kropman (2011)	90%
9.	Mavili E et al(2011)	88.1%
10.	Present study	90%

V. TERMINATION OF POPLITEAL ARTERY INCIDENCE OF TYPE I A PATTERN

CHART-4 (D)



TRIFURCATION PATTERN IN ADULT STUDY :

In an angiographic study done by Kim D et al(1989),trifurcation pattern was noted in 2.2% of cases.

According to S Z Pinda (2006) ,Ozgur Z(2009) and Day C P(2006) the incidence of trifurcation were 2.63%, 2.5% and 3.2 % respectively.

In a study done by Kil S W(2009), trifurcation was noted in 1.5% of cases.

According to Kropman et al(2011) ,the incidence trifurcation was 7%.

In the present study ,trifurcation pattern was observed in 6.7% of the specimens.

*This incidence coincides approximately with the study of Kropman et al.

*It was higher than incidence quoted by Kim D et al,S Z Pinda, Day CP, Ozgur and Kil SW.(Table 2D, Chart 5D)

TRIFURCATION PATTERN IN FOETAL STUDY:

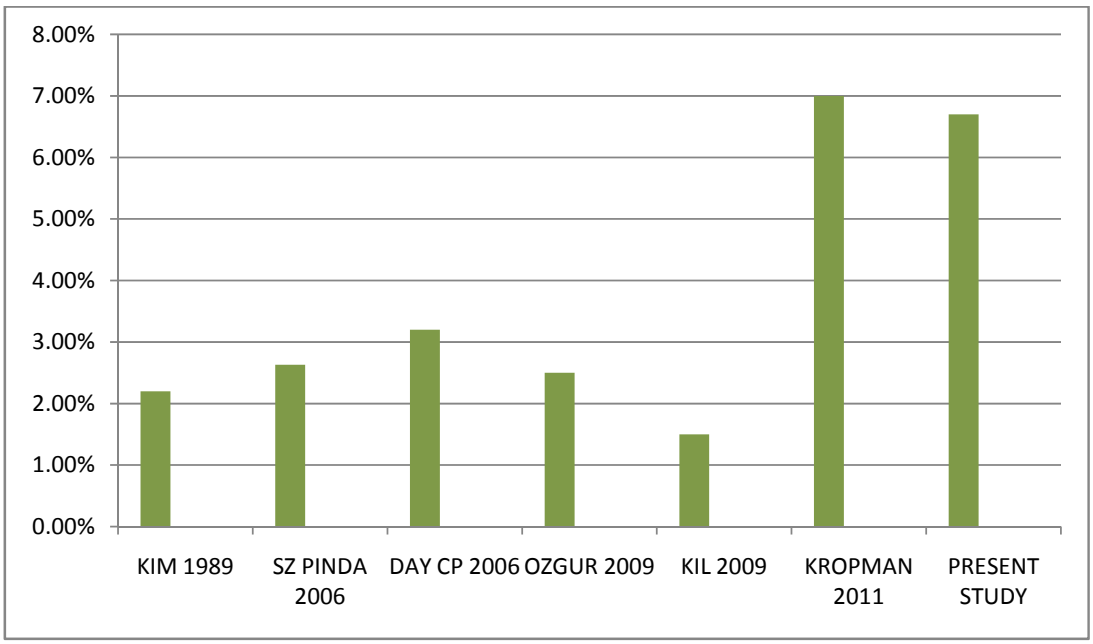
In present study , 10% of the specimens showed trifurcation of the popliteal artery into anterior tibial, posterior tibial and peroneal arteries.

TRIFURCATION OF POPLITEAL ARTERY INTO ATA, PTA & PA (TYPE 1B PATTERN)
TABLE-2(D)

S.NO	STUDIES	INCIDENCE OF TRIFURCATION(%)
1.	Kim D et al (1989)	2.2
2.	SZ Pinda M (2006)	2.63
3.	Day CP (2006)	3.2
4.	Ozgur Z et al (2009)	2.5
5.	Kil SW Jung GS (2009)	1.5
6.	Kropman et al (2011)	7
7.	Present study	6.7

TRIFURCATION OF POPLITEAL ARTERY INTO ANTERIOR TIBIAL, POSTERIOR TIBIAL AND PERONEAL ARTERIES.

CHART -5 (D)



HIGH ORIGIN OF ANTERIOR TIBIAL ARTERY : IN ADULT CADAVERS

According to Kim D et al(1989), Tindall AJ(2006) , Ozgur (2009) and Mavili etal(2011) the incidence of high level of origin of Anterior tibial artery were 5.6%, 6%,5% and 5.65 % respectively.

Day C P(2006) observed high level of origin of anterior tibial artery in 4.5% of cases.

According to S Z Pinda(2006), Kil SW (2009) and Kropman(2011) the incidence of high level origin of anterior tibial artery were 1.98%,1.2% and 2% respectively.

In the present study, Type IIA pattern- high level origin of anterior tibial artery was observed in 3.3% .

* It is lower than the data studied by Kim D et al, Tindall AJ,Day CP,Ozgur and Mavili.
* It is higher than the data studied by SZ Pinda,Kil SW and Kropman.

(Table 3D, Chart 6D)

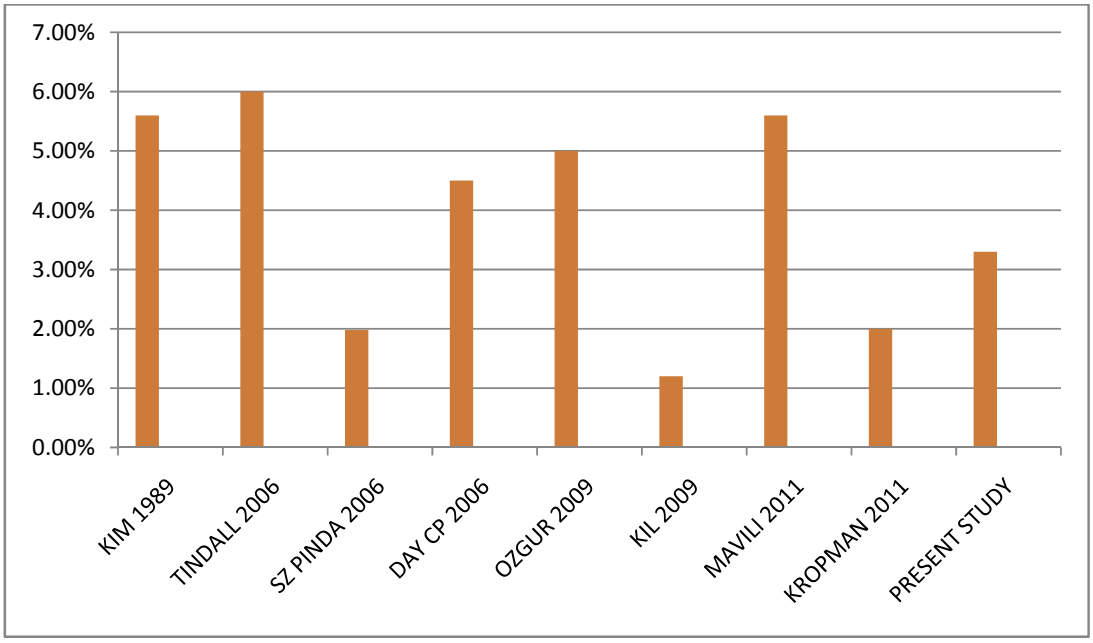
HIGH ORIGIN OF ANTERIOR TIBIAL ARTERY : IN ADULT CADAVERS

TABLE -3 (D)

S.No	STUDIES	INCIDENCE %
1.	Kim D et al (1989)	5.6
2.	Tindall AJ (2006)	6
3.	SZ Pinda(2006)	1.98
4.	Day CP,OrmeR(2006)	4.5
5.	Ozgur etal(2009)	5
6.	Kil SW etal(2009)	1.2
7.	Mavili et al(2011)	5.6
8.	Kropman et al(2011)	2
9.	Present study	3.3

HIGH ORIGIN OF ANTERIOR TIBIAL ARTERY
(ADULT CADAVERS)

CHART -6 (D)



HIGH ORIGIN OF POSTERIOR TIBIAL ARTERY:

Trotter (1940), Keen (1961), Morris (1961), John L Bardsley (1970) and Kim D Orron (1989) found high origin of posterior tibial artery above the inferior border of popliteus in about 5% of the specimens.

- In the present study, high level of origin of posterior tibial artery was not observed in adult Cadavers.

Zeliha KURTOGLU et al(2003) presented a case report , where there were two foetuses with high origin of posterior tibial artery proximal to lower border of popliteus .This variation fits into Type II B of Ducksoo Kim's classification.

- In the present foetal study , high level of origin of posterior tibial artery observed in 10% of the limbs.

VI. RELATION OF POPLITEAL ARTERY TO POPLITEAL VEIN AND TIBIAL NERVE:

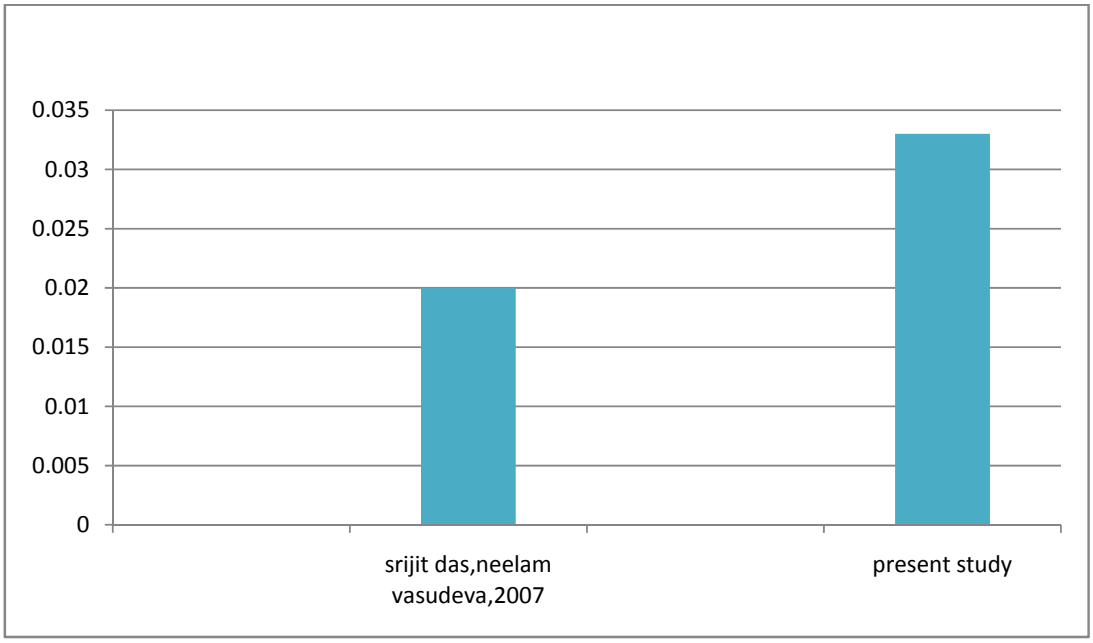
According to Cunningham(1996),Cornelius Rosse(1997), AnneMR AGUR(2009), Chummy S Sinnatamby (2011) and Gray(2012) ,the popliteal artery is deep to popliteal vein and tibial nerve throughout the course.

In a study done by Srijit Das, Neela Vasudeva(2007), 2% of specimens showed abnormal relation, that is the popliteal artery passed superficial to popliteal vein. In the present study, 96.7% of the specimens followed the normal relation.It coincides with relation quoted by Cunningham, Cornelius Rosse,Anne M R Agur,Chummy S Cinnatamby and Gray.

In the remaining 3.3% of the specimens, the popliteal artery was superficial to the popliteal vein but deep to the tibial nerve.

*This incidence of abnormal relation was higher than the incidence shown by Srijit Das,Neelam Vasudeva.(Chart 7 D)

RELATION OF POPLITEAL ARTERY TO THE POPLITEAL VEIN
CHART-7(D)



A RARE VARIANT - PRESENCE OF DOUBLE POPLITEAL VEIN WITH DOUBLE SUPERFICIAL FEMORAL VEIN

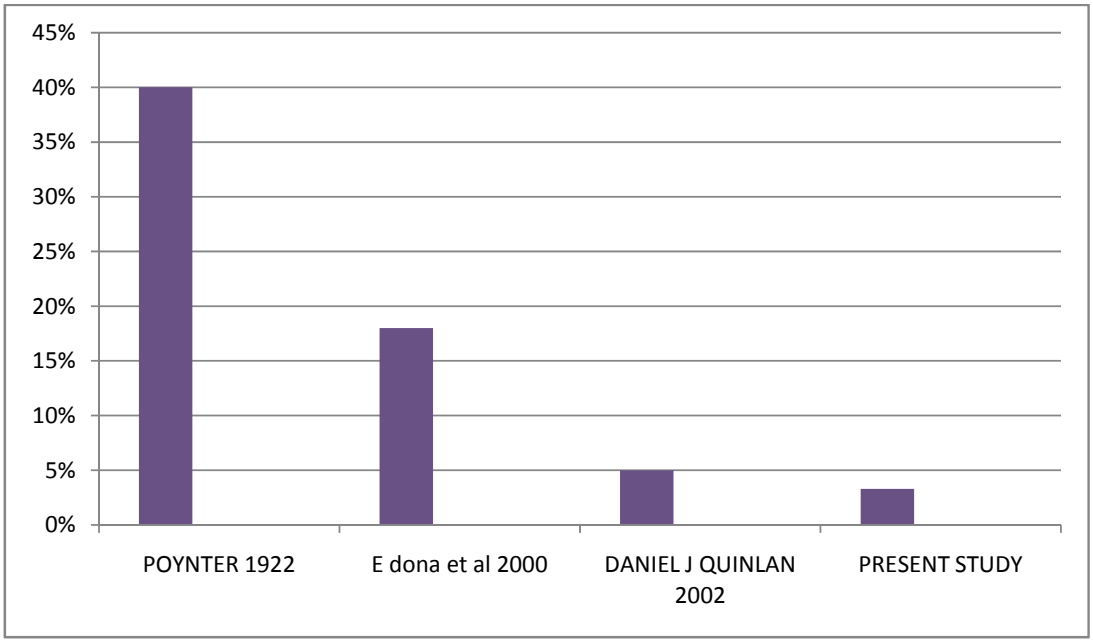
Poynter(1922) in his study found double popliteal vein in 40% of his subjects. In a study doneby E.Dona et al(2000) 18 % of cases shown double popliteal vein with double superficial femoral vein.

Daniel J. Quinlan (2002) found double popliteal vein in 5% of the cases.

In the present study 3.3% of the specimens showed double popliteal vein with double superficial femoral vein.

It is lower than the incidence noted by Poynter, E.Dona et al and Daniel J Quinlan. (Chart 8D)

DOUBLE POPLITEAL VEIN
CHART -5(D)



RADIOLOGICAL STUDY

Kim D (1989),Day C P(2006),Sz Pinda(2006) and Kil S W(2009) had done studies to analyze the popliteal artery branching pattern and its variations by reviewing lower limb angiograms. Most commonly observed branching patterns were trifurcation of popliteal artery, high origin of posterior tibial artery and high origin of anterior tibial artery.

According to Kim D et al, the incidence of trifurcation was 7.8%.

Day CP observed trifurcation pattern in 3.2 % of the cases.

S z Pinda and Kil SW noted trifurcation pattern in 2.63% and 1.5% of cases respectively.

In the present study,normal branching pattern were observed in nine images.

In one image alone trifurcation pattern was noted.

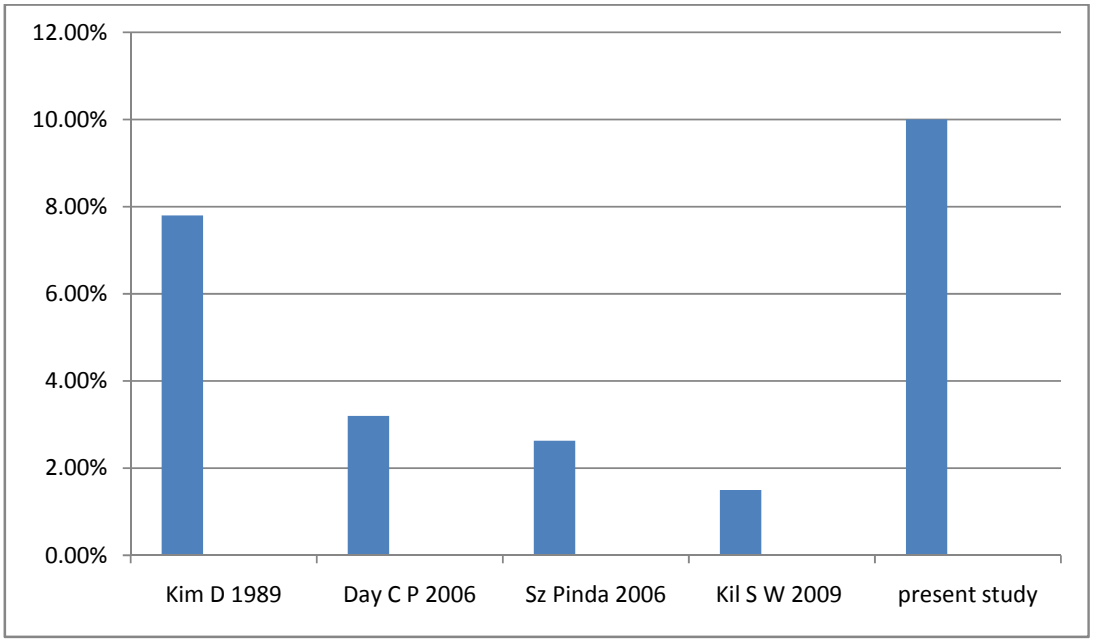
The incidence of variations(trifurcation pattern) was 10 % in the present study.It was higher than the incidence quoted by above authors. (Table 4D ,Chart 9 D)

INCIDENCE OF TRIFURCATION PATTERN IN ANGIOGRAPHIC STUDY

Table 4 (D)

S.No	Authors	Incidence(%)
1.	Kim D (1989)	7.8
2.	Day CP(2006)	3.2
3.	S Z Pinda(2006)	2.63
4.	Kil S W(2009)	1.5
5.	Present study	10

INCIDENCE OF TRIFURCATION PATTERN IN ANGIOGRAPHIC STUDY
CHART -9(D)



CONCLUSION

The present study of popliteal artery - its origin,length,diameter, branching pattern, relation and termination were analyzed by several researchers in the past and present century. The methods of study were routine dissection(cadaveric study) and radiological study. The popliteal artery was studied in 30 adult lower limb specimens ,10 foetal specimens and in 10 Computerised Tomographic angiograms.The observatory findings in the present study were more or less coincide with that of the observations of researchers in the past.

The following findings were observed:

- Unusual origin of inferior lateral genicular artery from anterior tibial artery
- Unusual origin of inferior medial genicular artery from common tibioperoneal trunk.
- Average length of popliteal artery = 17.35 cm.
- Average diameter of popliteal artery = 7.67 mm.
- Trifurcation of popliteal artery into anterior tibial, posterior tibial and peroneal arteries .
- High level of origin of anterior tibial artery.
- High level of origin of posterior tibial artery .
- Popliteal artery running superficial to the popliteal vein.
- Occurrence of double popliteal vein with double superficial femoral vein.
- Trifurcation pattern of the popliteal artery was noted in an image, out of the ten images in radiological study.

The anatomical knowledge of the popliteal artery and its variations are important in vascular and reconstructive surgeries .It is also useful in radiological procedures to avoid unexpected arterial injuries.

So the present study will be useful for the Surgeons and Radiologists in understanding the variations of the popliteal artery.

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